THE

CANADIAN

Naturalist and Geologist,

AND PROCEEDINGS OF THE

NATURAL HISTORY SOCIETY

OF MONTREAL.

CONDUCTED BY A COMMITTEE OF THE NATURAL HISTORY SOCIETY.

VOLUME VII.

Montreal:
PUBLISHED BY DAWSON BROTHERS, 23 GREAT ST. JAMES ST.
Jm 1862.

CANADIAN NATURALIST.

This Magazine is published bi-monthly, and is conducted by a Committee of the Natural History Society of Montreal.

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Page 244, line 15 from bottom, for "Environs," read "Emmons."
" " " 3 " " " "1850," read "1858."
" 247, " 11 " top, " "*Thisbe*," read "*Thysbe*."
" " " 3 " bottom, " "*McMurtrici*," read "*McMurtreei*."
" 248, " 6 " " " "*contiqua*," read "*contigua*."
" 249, " 8 " top, after "Spring" insert a full stop, and "Imago in."
" " " 9 " bottom, for "1448," read "1488."
" 251, " 9 " top, insert "on the outerside" after "accompanied."
" " " 18 " bottom, for "cones," read "leaves."
" 253, " 7 " top, for "*lineata*," read "*linea prima*."
" 255, " 6 " " " "incomplete," read "incompletely," and omit the comma after it.
" " " 14 " " " "*pisco*," read "*fusco*."
" " " 19 " " insert "is" after "hue."
" " " 21 " " for "uniform," read "cuneiform."
" 258, " 17 " bottom, for "*tragogoponis*," read "*tragopogonis*."
" 262, " 11 " top, insert a full stop after "White," and supply a capital H to "head."
" 264, " 18 " bottom, for "8," read "6."
" " " 7 " " " "*Cerrino*," read "*Cervino*."

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Page 36, line 7 from bottom, for "*denis*," read "*deviis*."
" 39, " 19 " " " "*converzaria*," read "*convergaria*."
" 40, " 18 " top, for "Sugar-bush," read "Round."
" " " 17 " bottom, for "*cosemia*," read "*coremia*."
" " " 16 " " " "*conspersæ*," read "*conspersa*."
" 41, " 16 " top, for "*fusio*," read "*fusco*."
" 121, " 7 " bottom, dele "F. 30th June."
" " " 5 " " for 13th," "read "30th."
" " " 3 " " after "Town" add "Line."
" 122, " 6 " " " "Sphagnum," dele "and."
" 123, " 10 " " for "distinct," read "district."
" 124, " 1 " " add "Limestone" before "rocks."
" 126, " 24 " " for "June," read "September."
" 131, " 16 " " " "pine," read "fine."
" " " 3 " " " "pinging," read "fringing."
" 133, " 4 " top, for "Chip-nambo," read "Chip-munk."
" " " 7 " " " "20th June," read "16th July."
" " after "*Smilacina stellata*," add "*Smilacina bifolia*, *Ker*. Abundant everywhere in woods; F. 20th June."
" 136, line 11 from top, for "30 Tune," read "30th June."
"Sugar-Bush Lake" frequently occurs instead of "Round Lake."
"St. Jean Lake" instead of "Eagle-nest Lake."
"Chain Lake" instead of "Balsam Lake."

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Page 81, last line for "*Plectrophanes nivalis*" read "*Fringilla (Junco) hyemalis*."
" 101, line 4th from bottom, for "those which escape," read "that which escapes"; and line 2nd from bottom, for "render," read "renders."
" 377, line 10 from top for "specimens" read "species.
" 380 " 3 " " after parenthesis, insert "between."
" 381 " 27 " " for "4th" read "3rd."

THE

CANADIAN

NATURALIST AND GEOLOGIST.

VOL. VII. FEBRUARY, 1862. No. 1.

ARTICLE I.—*On the Primitive Formations in Norway and in Canada, and their Mineral Wealth.* By THOMAS MACFARLANE.

(Presented to the Natural History Society.)

Some apology may appear necessary here for the use of a term, regarded by many geologists as calculated to perpetuate false ideas as to the character and origin of the series of rocks which it comprehends. The object of the following paper, however, being merely to point out certain analogies, and possibly, differences, between certain groups of rocks in Norway, and their equivalents in Canada, the name given them is of minor importance; and when it is considered how difficult it is to choose among the various terms which have been proposed and used for designating these formations, the one adopted in the above title may appear excusable, and not perhaps be deemed unserviceable on this occasion.

The groups of rocks, whose equivalents in Norway I propose in some measure to describe, are here known as the Laurentian system, the Huronian and the Metamorphic Silurian series. The first of these is generally designated the Primitive Gneiss formation, (*Urgneiss Formation*) in Germany and Scandinavia, while the two last mentioned groups make up what is termed there the Primitive Slate formation (*Urschiefer Formation*). I propose to describe these groups of rocks as they

occur in Norway, principally in regard to their petrographical and economic characters. I shall follow the order in which they are mentioned above, inserting at the end of each description, a few remarks on their development in Canada. The various facts related in the following descriptions are principally derived from such authorities as Naumann and Keilhau; my personal observations of the districts under notice, having only served to imprint on my mind the descriptions of these and other philosophers. The particulars narrated as to the various mining establishments, are to a great extent however, the results of my own experience and observation. As to the various features touched upon with regard to Canada, my principal source of information has of course been the reports of the officers of the Geological Survey.

I. The Primitive Gneiss Formation.

In Keilhau's "First attempt towards a Geological Map of Norway," as yet the only complete geological map of the country published, there are distinguished three geographical divisions, belonging to the Primitive Gneiss formation. separated from each other by groups of rocks, belonging either to the primitive slate, the eruptive granite and syenite, or to the Silurian series. The first of these is situated high up in Finmark, its most northern point being the North Cape. The second stretches from Beiern-fiord, north of Trondhiem, along the whole coast of Norway, southward to Christiansand, and from thence north-eastward to Kragerö. To this division, the gneiss districts of Kongsberg and Modum also belong. The third division is that lying to the eastward of Christiania-fiord and lake Miosen. These three divisions form only the most westerly parts of the great Primitive Gneiss formation, which extends through Sweden to Finland, and which is the characteristic feature of Scandinavian geology. The rocks which constitute this formation are the following:—

1. *Gneiss* in many varieties, the most common being what is called by Keilhau, *characteristic gneiss*, and which he thus describes. "The rock consists of white or reddish white feldspar, (orthoclase), grey quartz and black mica; the feldspar and quartz being combined with each other granularly, and the mica arranged in this mass in parallel layers; so that the structure is more an alternatively granular and slaty one, than a regularly slaty structure, with quite equal distributions of the three con-

stituents. In this way, there is caused a characteristic streaked appearance, sometimes with broad black or dark grey bands, and sometimes with the same streaks, narrower and farther from each other, according as the mica is more plentifully or more sparingly distributed in the rock. The grains of feldspar, quartz and mica, are mostly rather small in this variety of gneiss, so that it seldom becomes coarsely granular." *Gæa Norvegica*, p. 251. Through a gradual disappearance of the feldspar; the gneiss sometimes changes into mica schist, and through a gradual change in the position of the laminæ of mica, from that of parallel layers, to being irregularly distributed, the gneiss often passes into granite. Of the many varieties of gneiss, one deserves special notice; it has been called Porphyroid gneiss, and differs from the characteristic gneiss in containing lenticular-shaped aggregations of feldspar in a fine schistose matrix. It is this variety which has sometimes been called Eye gneiss.

2. *Hornblende gneiss*, differing from the characteristic gneiss in having exchanged the scales of mica for crystals of hornblende, arranged parallel with each other according to their longest axis. Sometimes however, the hornblende has only partially supplanted the mica, in which case intermediate varieties are formed between the hornblendic and common gneiss. Through gradual disappearance of both quartz and feldspar, the hornblende gneiss often changes into hornblende schist, and sometimes through a change in the structure of the rocks from schistose to granular, syenitic and greenstone rocks are formed.

3. *Granite* of the usual composition. It often occurs as a very coarse grained aggregation of dark red orthoclase with sparingly distributed quartz and mica.

4. *Mica schist*, composed of quartz and mica, with a schistose structure, and often containing garnets. It exhibits transitions into hornblendic schist as well as into gneiss, &c.

5. *Hornblendic schist*, forming transitions into greenstone, and when the structure continues coarse grained, into diorite and diabase.

6. *Chlorite schist*, consisting principally of chlorite and a little feldspar; here and there interwoven with fibres of hornblende.

7. *Talc schist*, mostly quartzose.

8. *Quartz*, as granular quartz rock, forming layers and zones; sometimes slaty, forming quartz slate.

9. *Euphotide*, consisting of brown diallage and white feldspar.

Other rocks allied to this, have been discovered in a good many localities, and described as gabbro.

10. *Serpentine*, sometimes occurs in such considerable masses as almost to entitle it to be regarded as a member of the formation. It is generally of a light yellow colour. The well known deposit of noble serpentine, occurring in the parish of Snarum, comes under this head.

11. *Granular limestone*, as marble, in layers and irregular masses.

12. *Conglomerates* and breccia, mostly the latter. One is described as "a granite-like combination of gneiss and granite," another "angular pieces of gneiss united by a gneissoid cement;" a third consists of "a gneissoid or granitic matrix, enclosing small fragments of other gneissoid rocks."

Besides the rocks above enumerated, there occur numberless varieties, forming transitions between these types of rock, some of which have been already adverted to. Sometimes, as Naumann remarks, "within small spaces, one and the same specific composition shews characters so quickly and so frequently changing, than we soon get accustomed to seek what is similar, only in the specific identity of the constituents, and not at all in the way or quantity in which they are combined." *Beiträge zur Kentniss Norwegens*, I. 188.

As the name Primitive Gneiss formation implies, the most widely distributed rock is the gneiss, either in its characteristic form or its varieties. The next most frequently recurring rocks are granite, mica schist and hornblende schist, or rocks related to these types. Some other rocks which I have enumerated, such as chlorite and talc schists, granular limestone and quartzite, occur in comparatively small quantity, while the remainder of those mentioned must be looked upon as uncommon occurrences.

As to the mode in which these rocks are associated with each other, the whole of them are arranged in parallel layers or zones, side by side, underlying or overlying each other. Hitherto no regular succession of rocks has been marked; they appear to be interstratified with each other without rule. The granitic masses are partly conformable with the parallel masses of the schistose rocks, and partly occur irregularly. It has been remarked that when the granite becomes more or less gneissoid, its masses are regularly interstratified with the other schistose rocks; but where the granite is totally free from all traces of gneissoid texture, the

form in which it occurs deviates more or less from that of layers or beds. A remarkable instance of this is described by Keilhau, as occurring near Norefield. There he saw a mass of granite, which on the whole, was gneissoid and bedded, gradually change at a certain place into a perfect granite, and then, in complete uninterrupted continuity, pierce the rock in the form of a dyke. Another instance is mentioned of a granite rock occurring in the schistose rocks, "partly in very regular layers, partly as isolated knolls and lumps, and partly as a multitude of veins; which in several places run through large portions of the neighbouring mountain as a close net-work." In spite of this however, this granitic rock showed in many places, a gneissoid structure. The relations of the hornblende schists and greenstones resemble those of the granite. The hornblende schist is regularly interstratified with the gneiss, mica schist and other rocks. Where its texture becomes less slaty, the layers or zones are not so continuous, but form, in the direction of the strike, elongated nuclei, which, with their hard masses, often stand out from the general surface, and thus form well distinguished peaks, such as Johnsknuden near Kongsberg, and Fagerlidknatten south-east in Nedenæs. Instances of crystalline amphibolites cutting the strata, occur in the most northern gneiss district, but these appear to have been formed much later than the gneiss. Mention is also made of a diorite, or feldspathic hornblende rock, occurring in veins in a granular mixture of quartz, feldspar and garnet, which latter rock appeared to form a transition into the gneiss.

One of the most striking features seen in the structure of this group of rocks, is the foldings and contortions, which the strata exhibit in all the divisions of the group. This is observed as well where no granitic masses are seen, as in the neighbourhood of such. On the high road from Hougsund to Kongsberg, and shortly before reaching the latter place, the traveller can observe, without dismounting, the most wonderful bends and contortions in the structure of the gneissoid rocks occurring there. Scheerer, in describing these contortions, compares them to the windings figured upon marbled paper. Naumann, in remarking on the same phenomena on the north-west coast, expresses himself as follows: "It is usually said of gneiss, that it is always clearly and regularly stratified. This assumes that the parallelism of the masses, of not too great extent, has a relation to one plane; that the positions of the planes of structure

within small distances, are only subjected to small, and generally gradual and continuous alterations; that these do not frequently shew sudden faults, or leaps in the most varied directions, within a few paces. If we however examine much of the gneiss of northern Bergenstift, we find exactly the opposite of this. Let one only observe the profiles which the play of the waves keeps so clearly and distinctly exposed on the rocky banks of Evenigfiord, Outer Dalsfiord, and especially of Söndelvsfiord. In what absolute indefiniteness, in what indescribable confusion is the structure of the masses exhibited! And yet there reigns the most unequivocal parallel structure within those thousand-fold meandering windings of the single zones, in which no rule, no law is evident, for the wonderful windings appear so lost in each other that neither drawing nor description is able to follow them."

In the presence of such contortions, and of local foldings on a larger scale, it is of course difficult to ascertain the general strike of the strata. It seems however, that in all the principal gneiss regions of Norway, the rocks run most generally north and south, or at least N.N.E. and S.S.W., and this, although there are numerous exceptions, appears to be the general strike. It seems also that a generalisation is possible as well with regard to the dip, as to the strike of the rocks constituting this group. The strata are almost always vertical or nearly so. This is the distinguishing character of the formation, and, *en passant*, let me remark the great difficulty hitherto experienced in all theorizings as to its origin. Horizontal and less inclined strata have indeed been remarked in several places, but they must be regarded as exceptional. The dip is almost always over 45°, generally 60° to 80°, while perfectly vertical strata are often observable. These much inclined strata may be traced continuously many miles on the above mentioned north-easterly strike, and taken together, strike and dip, form a remarkable feature in the architecture of these rocks. As Keilhau remarks, " there lies spread out before us an area of many thousand square miles, which shews only in a few places, any other than steeply inclined strata. In a great many, and indeed we may say in the most and greatest portions of this area, we see these steep strata following some law of regular course. We find them stretching away ten, twenty and often many more geographical miles, according to the same lines, and it appears to us that there where new fields of strike begin; it is still the same parallel masses which we have previously observed, and

which have only changed the direction of their strike." *Gœa Norvegica* I, 375.

The landscape features in the gneiss region vary much. We find in it sometimes tame hills, flat undulating plateaux, in which only the valleys cut into it, have exposed more rugged forms; but sometimes we find zigzag ridges, sharp peaks, and other remarkable mountain shapes. In the gneiss districts of the south, long-drawn, broad massive mountain ridges are most common, but on the north-west coast, the gneiss rises in rugged and fantastic forms above the surface of the water, in the numerous and intricate fiords of that region.

The mineral deposits of these districts are neither few nor uninteresting. Some of these are worked, and produce silver, copper, cobalt, nickel and iron, while others capable of yielding some of these metals or other minerals, remain unwrought or undeveloped. Foremost among the modes of occurrence of metals in this region, must be noticed the so-called *fahlbands.* These are not exclusively confined to the south of the *Fields* which run north-eastward across Norway at its broadest part, but it is there, and especially in the district of Buskerud, that they have experienced their greatest development. From a point to the west of Kongsberg, and near the junction with the so-called Tellemarken group, afterwards to be described, north-eastward to Tyrifiord, or to where the gneiss formation in Modum is overlaid by Silurian strata, there occurs a series of parallel zones of rock, having the same strike and dip as the rocks enclosing them, but distinguishable from these by the decomposed appearance and reddish-brown color which they present on the surface. This peculiar appearance, to which, according to Bōbert, they owe their distinguishing name (from *fahl* or *faul*, rotten, as the German miners, who first were employed in their exploration, termed them,) is attributable to the metallic sulphurets which they contain, and especially to iron pyrites; the ferric oxide and the sulphates produced in the oxidation of this being the coloring and decomposing agents. The quantity of metallic sulphurets necessary to produce this coloring and decomposing effect, is exceedingly small, and indeed it is sometimes scarcely possible to distinguish them, so finely disseminated are they through the mass of the rock constituting the fahlband. The sulphurets most generally present are common and magnetic iron pyrites, and copper pyrites; although blende and galena have both been mentioned as impregnating materials,

they are comparatively rare. Besides these, cobalt glance, cobaltiferous arsenical, and iron pyrites, nickeliferous magnetic pyrites, and argentiferous iron pyrites characterise peculiar localities. The impregnation seems to be altogether independent of the nature of the rock; gneiss, mica schist, hornblende schist, &c., being alike found constituting fahlbands. The continuity of these impregnated zones is frequently astonishing, some of them having been traced in the direction of their strike, nearly north and south, upwards of ten miles. Their course is often marked by depressions in the rocks, caused by their greater proneness to decomposition, and these depressions are frequently occupied by marshes and lakes. The thickness of these bands varies from a few feet to several hundred, and they have been frequently observed to split up and throw off side bands, some of which seem to connect with other similar zones. Although, as in the case of the glance cobalt and cobaltiferous mispickel, the impregnating material is sometimes the object of mining enterprise, it is generally on the veins or irregular masses occurring in these fahlbands, that the mines of the district are situated. Concentrations of metallic sulphurets or other minerals in fissures parallel with or crossing the strata, are by no means uncommon, and in some instances have given rise to very profitable mining. The metallic deposits which I propose to notice in connection with those fahlbands, are the silver mines of Kongsberg, the copper mines of Eker, the cobalt mines of Skuterud, and the nickel mines of Kingerike, all of which are at present being worked.

The rocks in which the fahlbands of Kongsberg occur are gneiss, mica schist and hornblende schist; other rocks, such as granite, talc schist and chlorite-schist, granitic gneiss and greenstones occur also in the immediate neighbourhood. Seven different fahlbands or groups of fahlbands have been recognized as existing in these rocks around Kongsberg, on every one of which, at some time or other since the year 1623, more or less mining has taken place. The two fahlbands which have been most minutely examined, have an average thickness, respectively, of 200 feet and 1100 feet. The impregnating sulphurets are iron pyrites, magnetic and copper pyrites; some of which appear to be argentiferous, since the fahlband itself contains one-eighth of an ounce silver per cwt. These fahlbands are intersected throughout the whole extent, about six miles, by numerous veins containing gen-

erally calcspar, fluorspar, quartz and metallic silver, and more sparingly, bitterspar, stilbite, prehnite harmotome, laumontite, anthracite, fibrous pyroxene, chrysotile, asbestus, actinolite, axinite, adularia, and perhaps albite, auriferous silver, metallic gold, horn silver, metallic arsenic, silver glance, red silver ore, galena, blende, magnetic, iron, and copper pyrites. These cross veins are exceedingly well developed within the fahlband, but beyond its limits they exhibit little distinctness or regularity, and moreover are totally destitute of silver. They do not however, while intersecting the fahlband, uniformly contain that valuable metal; on the contrary its occurrence there is almost as uncertain as that of a valuable ore in any other lode, but only within the limits of the fahlband can one expect to find it. The only rule which seems to have been ascertained to exist with regard to its distribution in the vein, within the fahlbands, is this—that where the latter is most strongly charged with the impregnating sulphurets, the vein at that point is richest in silver.

Such are the characters of the Kongsberg silver veins, striking examples of the influence which the wall-rocks exert on the contents of metallic lodes, and little liable to be neglected in theories regarding the filling of such. The connection between the pyritous impregnation of the fahlbands, and the argentiferous contents of the veins, necessitates the deduction that the silver has been derived from the pyrites, and as these have been found to be argentiferous, the deduction assumes the character of a fact itself. As to the mode in which the silver has been secreted various opinions may exist; the most probable appears to me to be the following:—

Through gradual contact with the waters containing oxygen, percolating through the rocks, the sulphurets, especially the iron pyrites, were decomposed, sulphates of protoxide and peroxide of iron, and sulphate of protoxide of silver being the results. The first named salt would be produced in the earlier stages of the decomposition, and removed; the two latter salts, produced towards the end of the process, can exist simultaneously in solution. On reaching the fissure, thus, in solution, they were met by some agent capable of precipitating the silver of the sulphate. The agent which seems to me to have accomplished this, is the sulphate of protoxide of iron, already alluded to as a product of the decomposition of the pyrites. The precipitation of silver salts by a solution of copperas, is a well known chemical reac-

tion, the products being metallic silver and sulphate of peroxide of iron.

The number of veins intersecting the fahlbands at Kongsberg is very great indeed. While the mines belonged to the Danish government, almost the whole of them received some share of attention, an extensive but rather desultory system of mining thus resulting. Since the Norwegian government undertook the working of the mines in 1812, a different system has been pursued, rather the other extreme, of working at too few points. Only three veins, those of *Kongen's Grube*, *Armen Grube*, and *Gottes-Hülfe-in-der-Noth*, have been the subject of mining explorations. However this may be, the mining of the last twenty to thirty years has been eminently successful, and a source of considerable revenue to the Norwegian government. On account of the shortness of the veins, their exploration is pursued chiefly downwards, but as yet, in going downwards, no diminution in richness has been observed. On the contrary, large masses of metallic silver, similar to those which obtained for the mines their celebrity in earlier times, have been recently found. These large masses are of course the exception, the most of the silver which is produced being separated from the vein-stone, in breaking it up, after its extraction from the mines. A large portion is also obtained in the stamping and washing of middle and poor ores at the mines, and in the same operations considerable quantities of more or less argentiferous *schlichs* and slimes are produced. The whole of these products are farther treated in the smelting-house in Kongsberg. The poorer slimes and schlichs, containing from $\frac{3}{8}$ to $1\frac{1}{2}$ oz. per cwt., are smelted with about one-and-a-half times their own weight of a basic slag, containing very much ferrous oxide, from a subsequent smelting, and about half their own weight of iron pyrites. The resulting products are a regulus of sulphuret of iron, containing $3\frac{1}{2}$ or 4 oz. of silver per cwt., and slags, containing $\frac{1}{20}$ oz. silver, which are set aside as useless. The raw regulus is roasted in heaps, and then smelted with one-and-a-half times its weight of rich slags from subsequent operations, containing from 8 to 9 oz. of silver. The regulus from this operation, as it is drawn off from the furnace into the crucible outside, is there stirred up with molten lead, poor in silver. From this results argentiferous lead (which is used over again in the same way, until it contains from $8\frac{1}{2}$ to 10 per cent silver,) and a lead regulus (sulphurets of iron, lead and

silver), containing of silver, 14 oz., per cwt. The slag from this second operation is what is used in the raw smelting. The lumps of metallic iron formed at the same time, and called iron swine, are worked up with the lead regulus, by being smelted together with the litharge and the hearths from the cupellation of the argentiferous lead. This operation produces lead containing only from 1½ to 2 per cent. silver, which is used in the treatment of the argentiferous regulus, as described above.

The lead regulus from this last smelting, which contains from 6 to 20 oz. of silver per cwt. is again smelted with lead, and its silver content is thus brought down to 4 or 6 ounces. It is then roasted and smelted with its own weight of poor slags containing 6 to 8 oz. of silver, when there results lead containing 4 to 5 lbs. of silver per cwt., which goes to the second operation; together with slags which are used in the first operation; and a copper regulus, containing 1 per cent silver, and 20 to 30 per cent copper. The latter is repeatedly smelted and treated with poor lead, until it contains not more than ½ oz. silver per cwt., when it is roasted and smelted to black copper.

The lead from the second operation, containing from 8½ to 10 per cent of silver, is cupelled in a German cupelling hearth, in which operation, hot air is used with great advantage. The resulting silver, and the rich silver ores from the mines, are refined in a furnace somewhat like the English cupelling furnace, the hearth of which rests on a well-arranged carriage, on which, after the operation is completed, the hearth is lowered on the one side, and the silver poured into the moulds standing prepared for it. The sweepings of this refinery, and the furnace hearths, are carefully smelted in a small furnace, and the products worked up, according to their contents in silver, in one or other of the operations already described.

The Eker copper mine consists of an irregular mass of iron and copper pyrites, situated on the strike of a fahlband, part of the impregnated rock of which is found to be so richly impregnated with copper pyrites as to be worth smelting. The ores are brought up by hand-picking at the mines, to about four per cent. They are then carted about four miles to the smelting house, where they are roasted in heaps. The roasted ore, with the addition of a little limestone, is smelted in shaft furnaces. The resulting regulus, of about 16 per cent, is concentrated by being again roasted and smelted, yielding a regulus of from 40 to 50 per cent. This

when again roasted and smelted produces black copper, which, being refined on the small hearth to *gahr* copper, is sold in Christiania or Hamburg.

The cobalt mine of Skuterud occurs on a fahlband, which has been traced about five miles, the rock being a quartzose mica schist. Layers of impregnated hornblende and actinolite schists are also of frequent occurrence. The rocks run north and south, and have a dip nearly vertical; sometimes inclined slightly to the east, sometimes to the west. In these rocks the following metallic minerals have been observed; magnetic, iron and copper pyrites, characterising the fahlband; cobalt glance, cobaltine, cobaltiferous mispickel, magnetic iron ore, graphite, and molybdenite are found more sparingly, impregnating the fahlband at certain places. These latter minerals do not occur in veins, but they are sometimes associated with quartz. They seem to form rather a succession of small layers, running parallel with the foliation of the rock. They are by no means generally distributed through the fahlband, and it has only been by taking out the whole mass of this, that the cobaltiferous portions have been got at hitherto. The fahlband itself has a breadth of from one to five fathoms, and it seems, toward the north, to be divided into two different bands, separated from each other by a large mass of dead rock. The mines were discovered in 1772, and have since been uninterruptedly worked, notwithstanding an extraordinary decrease in the value of the products. The treatment of the ores, as at present pursued, is as follows. The rocks are broken and sorted into rich and common ores. In the treatment of the smalls by means of a fall wash-work, washed ore of a very small size is produced, besides the above sorts. The whole of this ore is so finely disseminated, that it can only be advantageously treated by stamping and washing. The stamping mill is of the construction used in Saxony. The resulting stamp meal and slimes are concentrated first on percussion and then on sleeping tables. The rich ore treated in this manner yields per ton 86½ lbs. of *schlich*, containing 17.96 lbs. metallic cobalt. The common ore yields per ton 29 lbs. of schlich, containing 1.88 lbs. of cobalt. The poorer schlichs are further concentrated by being partly roasted, and smelted with an addition of some limestone and slag. The resulting slag is set aside. The regulus (sulpharseniurets of iron, cobalt and copper,) containing about 22 per cent metallic

cobalt, is roasted in reverberatory furnaces, and being mixed with the richer schlichs, which have also been calcined in the same way, forms what is called zaffre, containing about 30 per cent cobalt oxide. This is sent to market in England, where it is manufactured into cobalt oxide and smalt. A small quantity of the former product is manufactured on the spot in the humid way, but this quantity does not exceed one sixth of the whole amount of the cobalt oxide here produced in manufactured and unmanufactured products.

The fahlbands in the neighbourhood of Ertelien, and Ringerike, have not been so carefully studied as those of Kongsberg and and Skuterud; nevertheless it admits of no doubt, that the nickel mines of the former locality occur on impregnated zones of rock like the fahlbands. The deposits are irregular masses of magnetic iron pyrites containing two per cent of metallic nickel. Although a definite veinstone is not observable, it appears from the presence of selvages in various places, that the deposits partake of the nature of veins. Besides the nickeliferous pyrites, copper pyrites is produced at the mines in some quantity, but so contaminated with the former, as to be altogether useless as a copper ore. Occasionally, beautiful crystals of iron pyrites (pentagonal dodecahedrons), have been found, containing two per cent of metallic cobalt. The nickeliferous pyrites is sorted out at the mine, very pure, almost entirely free from rock. It is then roasted in heaps, and smelted in a shaft furnace with the addition of a little limestone. The resulting products are a very heavy slag, with is a basic silicate of ferrous oxide; a regulus of sulphuret of iron, containing about six per cent nickel, and iron swine, which collect in the interior of the furnace during the smelting, and interfere very much with its proper working. The regulus is again roasted in heaps and smelted, a more concentrated regulus with thirty per cent of nickel, resulting. The regulus, as well as the iron swine produced in both smeltings, are farther refined on a hearth similar to that used on the continent for refining copper. A farther scorification of iron takes place in this operation, and a regulus with fifty per cent of nickel and fifteen per cent of copper results, which after being ground to powder, is sent to market. It is mostly sent to Hamburg and sold to German nickel refiners. These mines were formerly wrought, and the pyrites roasted for the manufacture of copperas; it is only during the last fourteen years that they have been wrought for nickel.

Besides the four establishments here described, which are in full operation, there are a good many deposits connected with fahlbands, which are either abandoned, or have not as yet been worked. Of these the following may be mentioned—the cobalt mines of Svartefield, very similar in character to those of Skuterud, the copper works in Sognedalen, and on Kobberbergselven. There are also numerous localities of pyrites containing small quantities of nickel or cobalt, or both. The magnetic pyrites from Höiassen contains three per cent of nickel and six tenths per cent of cobalt; that from Rustand, six tenths per cent of nickel and one per cent of cobalt; that from Olafsbye one per cent of cobalt, and the iron pyrites from Sätersberg one per cent of cobalt.

There are however other deposits of pyrites in this formation, whose connection with fahlbands is more uncertain. Such localities for instance are those of Meinkier Grube, containing copper pyrites, nickeliferous magnetic pyrites and cobaltiferous iron pyrites; and Steenstrup's Kiesgrube, on Lyngdalselven, containing the same minerals. Dahll* looks upon these as contact deposits, and connects them with the intrusion of so-called gabbro.

Closely allied in nature to the fahlbands above described are certain other zones of impregnated rock, occuring in this formation. The impregnating material, however, is magnetic iron ore, the bands containing which scarcely possess such a length in the direction of the strike, as the fahlbands. Moreover the magnetic iron ore, besides occurring in this finely divided state, forms considerable beds in the impregnated zones referred to. It is from these deposits that the iron works of Sweden and Norway are supplied with the material from which their celebrated iron is prepared. These deposits are of frequent occurrence in the south of Norway, especially in the neighbourhood of Arendal, where there exist eighteen different beds of ore, which well repay the cost of working them. They are situated in a narrow straight zone, which runs parallel with the coast for a distance of six miles. The prevailing rock is gneiss, which graduates into mica and hornblende slate. The ore is magnetic oxyd, usually without any admixture of ferric oxide. The minerals most frequently accompanying it are augite, hornblende, garnet, epidote, calcspar, and the three essential constituents of the gneiss, especially mica. Besides these, about thirty other minerals have been mentioned as having been found in the deposits, but these are

* Om Kongsberg's Erts District; Christiana, 1860.

of rarer occurrence. The masses of ore appear flattened, almond-shaped, and drawn out parallel with the foliation of the enclosing rock. In the direction of the strike, they thin out, or branch off and disappear. Their average thickness is from two to six yards, but it sometimes reaches twenty yards. The iron works of Ulefoss, Fossum, Fröland, Näs and others, are all more or less dependent on these deposits for their ores. The situations of these iron works seem to have been chosen, less with a view to economically transporting the ore, than to taking advantage of the magnificent water powers, which exist everywhere in Norway. The fuel is charcoal, mostly from pine, and it has also to be carted considerable distances. The blast furnaces used, are partly similar to those used in Sweden, and partly to those used in Germany. They are thirty feet high, from four to four and a half feet wide at top, and from seven to eight at their widest part. The percentage of metallic iron contained in the mixture to be smelted, ranges from 25 to 42 per cent, and the average production of raw iron from a furnace is $2\frac{1}{2}$ tons daily. $1\frac{2}{3}$ tons of charcoal are consumed in the production of one ton of iron. The refining takes place on what are called "frisch hearths," and hammers are used in the further mechanical treatment of the resulting lumps of malleable iron. The iron produced, is like the Swedish, celebrated for its purity. It is shipped to Hamburg, and from thence mostly to America.

Large quantities of titaniferous iron ore occur at Ekersund and Snarum; that from the former locality contains 43 per cent of titanic acid. Phosphate of lime has also been worked and exported from the neighbourhood of Kragerö. With these I must close this sketch of the economical minerals of the primitive gneiss formation of Norway, and turn to compare it in its various features with that of Canada.

The parallelism of the Laurentian formation of Canada with the gneiss of Scandinavia was long ago pointed out by Sir William Logan, and in the more recent reports of the Geological Survey, especially those of 1853–56, we find the features of the Canadian formation fully described. The rocks there occurring are essentially the same as those of Norway. Keilhau's characteristic gneiss corresponds to the granitic or micaceous gneiss of Canada, and the hornblende gneiss of Norway is the syenitic or hornblendic gneiss of the Laurentian formation. Even the *eye gneiss* variety appears to exist here, and from the description, to be syno-

nymous with the reticulated gneiss. In corroboration of this I take the liberty of quoting the following remarks of Sir William Logan :—" In the Reports of the Survey, the Laurentian rocks have been described in general terms, as gneiss, interstratified with important masses of crystalline limestone. The term gneiss, strictly defined, signifies a granite with its elements, quartz, feldspar and mica, arranged in parallel planes, and containing a larger amount of mica than ordinary granite possesses, giving to the rock a schistose or lamellar structure. When hornblende, instead of mica, is associated with quartz and feldspar, the rock is termed syenite, but as there is no distinct specific single name for a rock containing these elements in a lamellar arrangement, it receives the appellation of syenitic gneiss. Gneiss rock then becomes divided into two kinds, granitic and syenitic gneiss, and the word gneiss would thus appear rather to indicate the lamellar arrangement than the mineral composition. Granitic and syenitic gneiss were the terms applied to these rocks in the first Reports; but as granite and syenite are considered rocks of igneous origin, and the epithets derived from them might be supposed to have a theoretical reference to such an origin of the gneiss, while at the same time it appears to me that the Laurentian series are altered sedimentary rocks, the epithets micaceous and hornblendic, have been given to the gneiss in later Reports, as the best mode of designating the mineral composition and lamellar arrrangement, without any reference whatever to the supposed origin of the rocks. (Report 1853–56, pp. 49 and 50.)

Further " The space between them (the bands of limestone) is occupied by gneiss, the banded structure of which is visible in a vast number of places, but a large part of the rock is coarse grained; the feldspar being in individuals, frequently attaining an inch and sometimes more in diameter, while the mica and the quartz, often accompanied by hornblende, and the former sometimes replaced by it, are distributed among the feldspar in such a manner as to give a reticulated aspect to the surface. Beds of this character are sometimes thin, but when thick and massive, which they usually are, they might upon a first inspection be mistaken for igneous instead of altered rocks. Upon a careful study of the case, however, it will be perceived that this reticulated structure is accompanied by an obscure arrangement of the meshes of the net-work, into parallel lines, which are found

to be conformable with the more distinctly banded portion of the strata." (*Ibid*, p. 9–10.)

Besides gneiss, the following rocks are mentioned as occurring in the Laurentian system. A crystalline aggregate of feldspar and quartz, granite in veins, mica and hornblende schists, chloritic gneiss, quartz-rock or quartzite, hypersthenite, serpentine, crystalline limestone, greenstone, hornblende rock, besides syenite and porphyry, which latter intrusive rocks however belong to a later period. These rocks are, on the whole, the same as those occurring in the primitive gneiss formation of Norway. Granite however does not seem to occur iu masses running parallel with the other rocks, unless we include under this denomination the above mentioned crystalline aggregate of feldspar and quartz. The hypersthene rocks described by Mr. Hunt in his interesting Report 1855, seem to be of a character similar to those occurring in Norway, and there described as gabbro and euphotide, however much the latter rocks, in their true types, differ from hypersthenite. The confusion existing among mineralogists regarding the nature of these rocks seems still to prevail, notwithtanding the able and exhaustive work of Mr. Hunt on the subject. As a proof of this, I may refer to a recent paper by Dahll on the ore district of Kongsberg, where there is a rock described as gabbro, which is composed of "violet or brownish labradorite and dark green hornblende. The color is that of the hornblende, consequently dark. Diallage, which is known by its shining lustre, is perhaps oftener present than has hitherto been demonstrated ; ilmenite is characteristic ; and magnetic pyrites occurs frequently ; with these, a little brown mica is frequently remarked." *Om Kongsberg's Erts District*, p. 16. Gabbro is commonly described as "a crystalline, granular or sometimes schistose mixture of feldspar or saussurite with diallage or smaragdite ;" *Cotta : Gesteinslehre*, p. 53. It is difficult to conceive how the above described rock resembles gabbro ; unless as Dahl further remarks concerning it, "labradorite is decisive of gabbro."*

(*Editor's note, by* T. Sterry Hunt.)

* The name of gabbro, originally employed by the Italians to designate a diallagic serpentine, is, by most modern authors, applied to a rock composed of a triclinic feldspar (such as labradorite) with pyroxene. When the latter is of the variety called hypersthene, the rock takes the name of hyperite or hypersthenite, but when it assumes the form of diallage or of smaragdite, the name of gabbro is given to the rock. In smar-

The serpentines of the Laurentian formation, are described by Mr. Hunt as of a paler colour than those of the metamorphic series. He failed to detect either nickel or chrome in them, and in his examination of a serpentine said to be from Modum in Norway, (probably that of Snarum, from its being associated with ilmenite), these metals were also absent. This is consequently another point of resemblance between the serpentines of the Laurentian formation and those of the Norwegian gneiss formation, distinguishing both of them from the serpentines of the metamorphic series. The crystalline limestones of the Laurentian formation appear to be much more frequent, and more regularly interstratified than those of the Norwegian gneiss formation, and this is one of the features in which a difference is remarkable between the two formations. In the Laurentian, as in the Norwegian gneiss formation, the gneiss is the prevailing rock, and interstratified with most of the rocks above mentioned. The strike of the strata of the Laurentian formation is most generally N. E. and S. W; or W. N. E. and S. S. W. and the dip much inclined, though perhaps generally less so than those of the Norwegian gneiss formation.

With regard to the economic minerals of the Laurentian formation, the existence of fahlbands similar to those of Norway seems to be uncertain. Still we find in the Geological Reports, descriptions of red-weathering rocks, which bear no slight resemblance to them, and should they be found to possess the character of fahlbands, a search for economic minerals in connection with them, would most likely be successful, because the metalliferous area is limited and well defined. The colour of the rock would assist in tracing it along its strike, and any veins crossing it or occurring in it would be easily recognised. Whether the pyrites of Daillebout occurs in connection with a fahl-

agdite we have an intimate mixture of pyroxene with hornblende, affording a transition to rocks composed of triclinic feldspars and hornblende; in other words to diorite and diabase. Those rocks which consist of such feldspars, with diallage or hypersthene, I arrange under the generic name of dolerite. When the feldspar in these predominates, and is granular or compact, including masses of diallage, the rock has been incorrectly called euphotide. This name was originally given by Haüy to a mixture of diallage or smaragdite with what he called saussurite, a mineral which by modern lithologists has been strangely confounded with compact feldspar, from which it is distinguished by its much greater gravity and hardness, and is, as I have elsewhere shown, a compact zoisite or epidote. The true epidotic euphotides however sometimes in-

band is uncertain; looking to the character of the mineral, which contains nickel and cobalt equivalent to 0·55 per cent of the oxides of these metals, I think it is very probable. The cobaltiferous pyrites of Brockville seems, on the other hand, to be an independent deposit, seeing that it occurs in such extraordinary quantity. I found the compact variety to contain metallic cobalt corresponding to 0.50 per cent cobalt oxide. This result was confirmed by Mr. Hunt, who found 0·52 per cent. In the neighbourhood of the copper mine of Escott, I found no traces of anything resembling fahlbands, so that I am inclined to parallelize this locality with the pyritiferous deposits above described as occurring at Meinkier and Lyngdalselven, independent of the fahlbands. In no particular does the Laurentian formation so much resemble the primitive gneiss formation of Norway, as in containing those enormous deposits of magnetic iron ore, which occur in the townships of Madoc, Marmora, Crosby, Hull, &c. In extent however, the Canadian deposits far surpass the Norwegian. In like manner, the deposits of titaniferous iron of Bay St. Paul far surpass in extent those of Snarum and Ekersund. The phosphate of lime of Burgess and Elmsley, differs from the deposits of the same mineral in Norway, in being associated with crystalline limestone, and in occurring in far greater quantities.

I have thus endeavoured, as far as my knowledge of Canadian geology permits, to parallelize the various features of the Laurentian and primitive gneiss formations. Doubtless many who are more intimately acquainted with the geology of this country will be able to recognize further points of resemblance, and in view of this possibility, I have described the Norwegian formation at greater length. I shall be guided by the same considerations in describing the two other groups of rocks which I have yet to compare with their Canadian equivalents. I cannot however

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clude triclinic feldspars, and thus pass into diallagic dolerite or gabbro. The feldspathic rocks of the Laurentian system, above referred to, consist of labradorite, andesine, or some related feldspar, and often include pyroxene, which from a variety like sahlite, passes into hypersthene and diallage, giving rise to hypersthenite, and to the incorrectly named gabbro and euphotide of most modern lithologists. The rock from Kongsberg, as above described by Dahll, except in the substitution of hornblende for pyroxene, agrees closely with a variety of diallagic dolerite common in the Laurentian series. For further illustrations of this subject, see a paper on Euphotide and Saussurite, in Silliman's Journal of Science for March 1859.

leave this division of my subject, without referring to one important difference which exists between Norway and Canada, in regard to the economic minerals of this group.

In the former country, despite its comparative poverty, those deposits are well developed. In Canada they remain dead and unproductive. Why they should be so, it is difficult to say. Canada has the advantage of Norway in having richer minèral deposits, better means of transport by its canals and railways, and a much greater command of capital. With regard to fuel, both charcoal and imported coal, it is equally as well situated as Norway, and although labour is much dearer than in the latter country, there is every prospect of this disadvantage becoming less considerable. The severity of the winter presents no greater hindrances to mining in Canada than in Norway, and Canada is rapidly acquiring the skilled labour essential for successful mining. In view of these considerations therefore, one may hope that the great accumulation of economic minerals in Canada will soon become one of her most important sources of national wealth.

(To be continued.)

ARTICLE II.—*On the Shore Zones and Limits of Marine Plants on the North Eastern Coast of the United States.* By the REV. ALEX. F. KEMP.

(Read before the Botanical Society of Canada, at Kingston.)

While spending a vacation, during the month of August, 1861, at Peak's Island, in the State of Maine, and Bay of Casco, it was a special and very profitable amusement of mine, to note the botanical features of that region of country. The season was too far advanced to find many of the beautiful land plants which have their special home in the Northern United States. The *Kalmia angustifolia* was out of flower, and its branches covered with seed. The fragrant *Myrica cerifera* was in a similar condition. The *Rosa blanda*, though here very abundant, was out of season. *Gerardia maritima* was in fine condition, and in one or two swampy localities near the shore, very abundant. Along with it, but more generally diffused, *Spiranthes gracilis*, grew in beautiful profusion, and shed forth its delicate lily fragrance. In one locality I found the pretty blue *Trichostema dichotomum*, and in another the curious little Pine weed *Hypericum Sarothra*. Other plants common to Canada and the United States flourished

in much profusion. I also collected, and figured in my note book, fifty one species of the larger fungi, some of them very beautiful and curious. The chief field of my researches was, however, in the department of marine plants. These were specially interesting to me as I had not before had sufficient opportunity of personally examining their peculiar habits and growth in the United States. I first sought out the best localities in which to collect good specimens; afterwards I made a collection of all the plants that could be found at this season of the year. I was somewhat disappointed at the limited number of species which the coast afforded, and believe that, from some cause or other, there was a short crop that season of many of the more delicate and beautiful forms. The Fuci were, however, in great perfection, and astonishing profusion. The rocks were everywhere clothed with their dark and mottled drapery, and on the shores of every little bay they lay in dense aud matted beds, in which were mingled such other species of Algæ, and of animals, as inhabit the rocks of the sea coast.

It occurred to me that it would be a pleasant and an interesting occupation to note the lines or zones upon the rocks and shores at which the various plants found a special home, and the limits to which they were accustomed to travel. A very cursory survey convinced me that each plant had its favorite shore region within which it grew to perfection, and beyond which it either ceased to grow, or became dwarfed in its form. I was aware that all the Hand Books on the Algæ had noted the special localities of each species, whether it grew at high or low water mark, at half tide or in deep water; but I was not aware that in any of the books, shore lines and limits of plant growth had been made the subject of special treatment. This subject may be regarded as a minor branch of the important enquiry as to the geographical distribution of plants. It is akin to the phenomena of the vertical distribution of land plants, on the slopes and peaks of mountains. Perhaps, something interesting may come of the observations which leisure and opportunity permitted me to make at Peak's Island. I am far from thinking that my knowledge of the subject is yet so complete as to entitle me to speak with any degree of confidence upon it. All scientific observers know that a first survey of any subject is almost necessarily imperfect in its details, and that these can only be fully worked out by repeated examinations under every variety of circumstance. A beginning

must however be made of the induction of particulars, if any satisfactory conclusions are to be reached, in this as in every other branch of scientific enquiry. What I have to say at this time on this subject, imperfect though it must be, may yet, as a beginning, and so far as it goes, be sufficiently accurate to afford reliable information to those who have not made this branch of botany their study; it may also, as a starting point, lead to further observations in the same field on the part of those who are adepts in the sub-kingdom of Sea-Weeds.

The tides along the Atlantic shores of the United States rise about fifteen or twenty feet, and in their range afford a fine field of research for the naturalist. This tidal shore I would divide into six distinct zones.

I. The Drift or beach Zone.
II. The Ulva Zone.
III. The Fucus Zone.
IV. The Laminaria Zone.
V. The Chondrus Zone.
VI. The Deep sea Zone.

I. The Drift Zone.

The first of these is not properly a zone of vegetation. Nothing grows in it, to my knowledge, excepting millions of sea lice. It is however important to the amateur collector. Here the waves drive up masses of all the kinds of sea-weeds which the coast affords. After a storm from the ocean no better field of research can be resorted to for fine specimens of Algæ. Ladies who are in search of " mosses " for ornamental work, need go no farther to find all that they want, than to this line on the beach. Timid collectors too, who fear to wet their feet in the pools, or to hazard their limbs on the slippery rocks of the lower shore, will find enough to fill their wallets at zone number one. I note it chiefly for the benefit of young collectors, and to point out to them, that in prosecuting the study of marine plants, they may, through the potent agencies of the waves and the tides, do so without the least inconvenience to themselves.

II. The *Ulva* Zone.

I call this zone by the name of the beautiful green *Ulva*, because this genus of plants has its chief habitat in the warm pools and on the rocks which are found a little below high water mark. The whole order *Ulvaceæ*, indeed, flourish best in this locality over the wide geographical limits within which it is

found. Here almost all its species grow to their greatest perfection, both as to quality and quantity. A reason for this may be that the bright green color which distinguishes most of the species requires a larger amount of sun light for its production than the olive, and red-colored plants require which inhabit lower zones and deeper water. The color of those plants of the order *Ulvaceæ* which travel into deep water, is for the most part of a darker hue than those which grow in shallow places. I have also noted that the color of specimens from the tropical and subtropical regions is more brilliant and permanent than is that of plants in the colder regions of the north. Some of the species of this order have besides a special love for fresh water, either in the shape of land drainage or of shallow streams. *Enteromorpha clathrata* for example may often be seen travelling far up fresh water rivulets.

In this zone *Ulva latissima* is found in great abundance and beauty. Wherever pools of water are left by the tide this plant finds a happy home; rejoicing in the heat and light of the sun it spreads out its broad ruffled fronds, with a gentle undulating motion in the water. It is often gemmed with glistening globules of eliminated oxygen, thus purifying the water and contributing both to the health and shelter of the innumerable animals which live in the same pools. I did not find *Ulva Linza* here, although it is found abundantly on other parts of the coast. The Ulva passes readily down into deeper water, and may be found on rocks and in the pools of the third zone, but although it grows well there it is yet neither so beautiful nor so luxuriant as it is in its own natural home.

The most abundant genus however of the order Ulvaceæ to be found in this zone is that of *Enteromorpha.* I found the four species, *E. intestinalis*, *E. compressa*, *E. clathrata* and *E. Hopkirkii* with their various forms growing in profusion in the pools, and on the shores on places where fresh water was present. The upper part of their fronds float on the surfaces of the pools, after the manner of fresh water confervæ, and are, like them, inflated by the oxygen which their fronds rapidly eliminate. The apicies of these plants are frequently blanched and much decayed from exposure, their color is also of a lighter and more yellowish tinge than is that of the *Ulva.* The last species *E. Hopkirkii* is rare both in America and in Europe, and is readily known by the confervoid articulation of its ramulæ. Along with these, and firmly

adhering to the rocks, clumps of *Cladophora rupestris*, *C. uncialis*, and *C. flexuosa* were found. Masses of the bright green and gelatinous *Hormotrichum Younganum* were also found adhering to the edges of the rocks. These plants have a considerable range of growth and some of the Cladophoræ may be found in fine condition as far down as the lower limits of the third zone, but there they assume a deeper green color and stronger texture. Entangled among other plants, the dark green crisp and tortuous *Chætomorpha litorea* finds also a home. This plant has however a considerable range of growth, and is not specially abundant in any place only it does not grow in very deep water or far down on the shore. Of the *Enteromorpha* it may be remarked that it is very troublesome to the fishermen, as it infests the bottoms of the boats, and greatly retards their progress in sailing. It adheres to them with great tenacity, and in an incredible short space of time, covers them with a perfect forest of long green fronds. The only remedy for this pest is frequent scraping, burning and tarring.

In this second zone there are found, besides, stragglers from the zone beneath.

The chief and most notable of these is a dwarf species of *Fucus*. It grows in the corners aud crevices of the water pools, and travels very little beyond the Ulva Zone. In its dry state it has much the appearance of a *Dictyota*, but in its fresh condition it is thick and leathery as a *Fucus*. It may be a dwarf form of *Fucus vesiculosus*, but in no case did I either find air vessels or terminal receptacles upon it. It had always the same appearance: a plain narrow frond with a slender midrib frequently bifurcating in a dichotomus manner. Its colour is a pale olive. Hervey does not notice this plant in his Nereis Borealis but in his Manual he describes a plant of the same kind as a variety of *Fucus vesiculosus* under the name of *F. Balticus*, stating at the same time that it is probably a depauperised condition of *F. vesiculosus*. It may be so, but I was not able to trace the connection between the two by intermediate forms. I am disposed to think that it is entitled to a specific name, and that it may retain that of *F. Balticus*. Dwarf specimens of *Fucus nodosus* are also found creeping up into this zone, but regarding these no doubt can be entertained. Their linear form and occasionally inflated fronds sufficiently indicate their connection and origin. The rocks are also covered with a soft velvety green substance apparently made up of a

species of a confervoid plant and a very small Diatom. These I was not able to examine in their fresh state under a high power of the microscope, and in the dry state I find the confervoid plant altogether broken up and without form.

III. The *Fucus* Zone.

This third zone I would divide into three distinct sub-zones:

(1) *The nodosus.*

(2) *The vesiculosus.*

(3) *The furcatus.*

(1) The first or uppermost of these is almost exclusively occupied with *Fucus nodosus.* This plant grows to great perfection on the Atlantic coast of America. It has a range as far south as New York Bay. Every where it is found within this region fringing the shores and the rocks near high water mark. For its proper growth it requires evidently a measure of dryness, a good deal of light, and showers of rain. It is the hardiest of all the Fuci, and may be found in a depauperised state high up in fresh water creeks, or in rivulets. It is a hard dark olive and ribless plant, easily known by its slightly petioled and club-shaped branchlets, and by the large bladder-like air vessels formed by the inflation of its fronds, with which it is crowded. On this coast it covers a belt of shore of from one to three yards in breadth. It is frequently covered with *Ceramium rubrum.* In many places so densely does this parasite grow upon it, that it gives quite a feature to the plant.

(2) In the next sub-zone *Fucus vesiculosus* grows in great profusion. It seems to retain more water among its fronds than the previous more leathery plant. It is easily known by its broader ribbed frond, its air vessels, occurring frequently in pairs, and by the viscid character of its terminal receptacles. This plant is also infested with *Ceramium, rubrum* in some of its many varieties, with *C. fastigiatum* and sometimes also with the parasitic plants *Elachista fucicola* and *Ectocarpus siliculosus.* It occupies a space on the shore of from one to three yards in breadth, completely covering with its wet and slimy fronds, the rocks upon which it grows.

(3) *Fucus furcatus.*—Occupies the chief place in this sub-zone, and is unquestionably the most beautiful and graceful of the three. Harvey remarks in his Nereis Borealis, that he is unacquainted with this species. We wonder at this, as it is a very abundant and remarkable plant on the coast of Maine. He describes it on

the authority of Aghardh under this name "as having a com- "pressed stipes expanding into a linear dichotomus ribbed *frond*; "*margin* very entire; air vessels none; *receptacles* elongate, "linear, flattish repeatedly forked, three inches in length, scarcely "thicker than the frond, and tapering towards the apices." This plant is found at the ordinary low water mark and is scarcely ever altogether out of the water. It retains a great deal of water in its meshes, as the fronds, lying flat upon one another, do not permit the water to escape. It is of a lighter olive color in the water than the other plants of the genus. It measures from 1 to 2½ feet in length, and is remarkably strong and firmly attached to the rock by its discoid root. Waving gracefully in the rising or falling tide, or lashed by the angry waves, it presents an interesting and beautiful appearance. Under its folds a variety of *Chondrus*, like that described as *C. Norvegicus* in Hervey's Manual, is found in great abundance, adhering to the rocks. The curious plant called *Gigartina mamillosa*, but which seems in all its features more allied to Chondrus than to Gigartina, finds a secure habitation under its dense folds. On the lower part of its stems *Elachista fucicola* grows in great profusion affording a byssoid ornamentation to that portion of the plant.

There can be no doubt that these three plants occupy always the same relative positions to one another in which they are here found. The line of division may not, it is true, be so well marked as are the lines of garden plots; to some extent indeed they mingle at their boundaries; but there are considerable centres in which they are found in great luxuriance, and in which no other allied species grow. *F. nodosus* is the hardiest of all the Fuci, and from its thicker and more leathery character can best withstand the drying influences of the atmosphere and the sun. These are indeed the conditions in which it grows to its fullest dimensions. *F. vesiculosus* is more liable to be affected by light and heat than *nodosus*, and while it requires a measure of these for its full growth, it can yet do with less than its neighbour. *F. furcatus* again is more tender than either, and is less able to resist the influence of the atmosphere. It is consequently from its position two thirds less time out of the water than *F. nodosus* and one third less than *F. vesiculosus*. In all probability it will also contain fully more iodine than either of these plants, and would form a better manure for the fields.

Within this zone there are, on the Atlantic coast, and wherever rocks abound, frequent pools of water more or less large and deep, in which may be found many of the hardier species of deep sea plants. In the lower belt ot this zone and contiguous to *F. furcatus*, I found *Chondrus crispus*, the well known *Carigeen Moss* growing in much luxuriance, having crept up thus far from its natural home. But the plant which more generally filled these pools was *Halosaccion ramentaceum.* In every variety of form it abounded there, but frequently in so depauperized a state, as to indicate that it was not exactly in its native home. Specimens of the largest size to which this plant attains I did not often find, but in one form or another it was present in great abundance. The curious and pretty plant called *Cystoclonium purpurascens*, together with *Hypnea musciformis*, had here also their natural home and grew in great perfection. They too to some extent are deep sea plants, but for the most part they covet a home in the rocky pools of the shore. *Chordaria flagelliformis* threw out its long filamentous fronds in every pool of this zone, and in many crevices of the rocks left bare by the tide. Here also *Rhodymenia palmata* the dulse of America, with its blood red frond, grew in great beauty and abundance both on the rocks and as a parasite on other Algae. But one of the most striking inhabitants of this zone is *Chaetomorpha melagonium.* Its long pea-green filaments afford a pleasing variety of colour. It grows often solitary but is not unfrequently clustered together in considerable bunches, *Cladophoræ* and *Rhodymenia palmata*, and *Ulva latissima*, commonly growing as parasites on the ends of its fronds. Occasionally a bunch of *Delesseria sinuosa* is found in the deeper and more shady pools. Once only I found a little plant of *D. alata* and *Euthora cristata*, but these are stragglers and seldom flourish out of deep water. The inflated fronds of *Asperococcus sinuosus*, a deep sea plant, were occasionally found. In the more sheltered places, large patches of *Corallina officinalis* grew very luxuriantly. Its horny pinnate branches, with the reddish tinge of its natural state, render it a very pleasing object in the water. This curious calcareous plant has a wide range of growth, but it does not travel higher up on the shore than the second line of the Fucus zone. It is however found at a considerable depth in the sea. I constantly found it attached to the roots of the large deep sea plants, and in some places it grows at the depth of fifty fathoms. A *Gigartina*, probably *G. tenax*, is also found inhabiting these

pools in great abundance, and quite at home in them. It is a rigid dark red plant bifurcating twice or thrice. A curious plant called *Furcellaria fastigiatia* is also a characteristic denizen of this zone. Its soft texture and forked apices are its characteristic features. Over the three belts of this zone and attached to the rocks in considerable masses, the very gelatinous *Porphyra lacinata* is found in perfect condition. This is the *laver* of the Scotch shore. It is a most widely diffused plant, but chiefly inhabits the northern waters; in southern latitudes it becomes delicate and small.

The third line of the zone is perhaps the finest field of any on the shore in which to search for growing specimens of the prevailing shore plants, and the more hardy inhabitants of the deep sea. Time and labour spent here will always be rewarded by the discovery of either unknown species, or of new varieties and habitats of those already known.

IV. The fourth zone is that of the *Laminaria.*

This is the largest kind of marine plants. The species never leave the water if they can help it, and are found in the pools which touch upon low water mark. They often grow in the channels and grooves of rock, up which the water, at low tides, is generally flowing at the rise and fall of every wave. The *Laminaria digitata* which grows here, either rooted to the rock or to some large shell, such as *Mytillus edulis*, with its strong fibrous roots, attains sometimes to a great size. Its stem is not generally more than two or three feet in length, sometimes it is much shorter, but the frond which grows upon it is frequently from four to six feet long and split up into numerous laminæ. This is a strong leathery plant, of a dark olive colour, and conspicuous for its size among the drift along the whole northern shore of America. *L. saccharina* is next to it in size, with its variety *latifolia*, but its stem is somewhat shorter, and its frond narrower and longer, and its margin frequently waved and fringed. These long oar-like plants are very abundant, and are remarkable for the density of their structure. When tossed about by the strong waves of the ocean, they lash the shore with great force. When driven ashore they generally bring the piece of rock or the shell to which they are attached with them. They are the favorite haunts of innumerable *Sertulariæ*, *Bryozoæ* and *Sponges.* The beautiful dulse, or *Rodymenia palmata*, very generally grows in luxuriant profusion upon their stems. The smaller species, *L. Phyllitis* and *L. dermatodea*,

are also found along with these in all stages of growth. The Sea Colander or *Agarum Turneri* is here, too, a well known plant. It grows sometimes to the size of from ten to twelve feet. For the most part it is a deep water plant, but it yet frequently appears on the shore among the *Laminaria*. Only dwarf specimens are however found here, showing that this is not its natural home. I picked up a small plant of this species which had an anomalous peculiarity in the shape of a trilaminate frond. "From the centre of its laminæ along its whole length there projects a wing, "or additional lamina, making with the two halves of the true "leaf a third lamina" This peculiarity has evidently arisen from the splitting up of one of the laminæ of the frond. I would infer this from the fact that the lamina to which the third one is inclined, and to which it is united at the midrib, is thinner than the lamina on the other side of the midrib. The perforations also on the two associated laminæ correspond in many respects, although the mother lamina seems to have grown considerably since the separation of one half of its substance took place. I am particular in noting this, as I find in Harvey's Nereis Borealis a Laminaria described as *L. trilaminata* on account of a peculiarity of identically the same kind as that which I have noted. The description of that species is taken from Olney's list of the Rhode Island plants, published in the proceedings of the Providence Franklin Society. Harvey is doubtful about it, and had he seen a good specimen of the so called plant, he would at once have detected its origin, and refused it a place as a distinct species. It can be considered as nothing more than an anomalous form. The most interesting and curious of the plants that are found in this belt is the *Alaria esculenta*. It is found on the Atlantic shores of America, from Newfoundland to Cape Cod, and is abundant on the west coast of Scotland and Ireland. "It has a root of many grasping fibres, a stem naked at the base and cylindrical, from *two* to *four* lines in diameter, and from eight to ten inches in length. On its lower half there are numerous stemless leaflets, above which the stem is winged on each side, and passes gradually into the midrib of a foliaceous frond which is from one to twenty feet or more in length."—*Harv.* It is of a bright olive colour, and covered over with a very adhesive mucous. Unlike most others of the order to which it belongs it adheres closely to paper. Its natural home seems to be about low water mark, among the rocks of the shore. It is in many respects a beautiful plant, and its

bearded stem gives it a striking and characteristic appearance. The whole breadth of this zone does not exceed one yard.

V. The fifth zone is that of the *Chondrus.*

Perhaps this belt is scarcely entitled to a separate place. It blends so much with the preceding as scarcely to be distinguishable from it. Nevertheless *Chondrus* occupies so conspicuous a place here, and drives out of this, its special retreat, almost all other plants, that it appears entitled to be considered as possessing a separate territory or home. I was not aware of the special locality of this plentiful and useful plant, until I had examined the shore at extreme *neap* tide. I then found much to my astonishment that the lowest part of the shore rocks which the tide had left bare, but which were only bare at very low water, were deserted by almost every other species, and that *Chondrus* alone covered every rock with a densely matted carpet. So closely did the plant grow that not a particle of the rock could be seen. Only in the interstices of the rocks did some plants of *Laminaria*, *Alaria*, and *Chondaria* grow, all else was in undisputed possession of *Chondrus.* This region is apparently its central home; here it retains its normal purplish-red colour, and is in all its parts regularly developed. It is however a great traveller. Specimens of it may be found in pools far up on the shore, even among the green Ulva, and it extends its growth far out into the deep water. This is the only really useful plant on the coast. It is very gelatinous, and is considered nourishing as an article of food, it makes very good *blanc mange*, and on being mixed with other materials is said to be capital feed for cattle and pigs. For invalids it is often recommended. The article is imported from Europe to this country, blanched and free from salt, and is kept by most druggists. It grows in such immeasurable abundance along the whole Atlantic coast of America from Nova Scotia to Long Island, that it seems like bringing coals to Newcastle to import it to this country.

VI. The Deep Sea Zone.

Under cover of the deep blue waters of the ocean the finest and most beautiful of the marine plants are generally to be found. Many of the larger plants attain also their largest dimensions in the deep waters. A large number of species belonging to the order *Laminareaceæ* find their natural home in the deep sea. One remarkable plant of this order is found growing only in deep water; and for this locality its structure is specially fitted; I re-

fer to *L. longicrucis.* This is a noble plant. Its stem is frequently eight to twelve feet long, slender at the base as it springs from its root of clasping fibres, it gradually widens upward to an inch in diameter, where it is hollow or tubular, and thence tapering to the apex, terminates in a broadly expanding oblong lanceolate frond, beautifully waved at the margins and obtuse at the termination. The colour of the stem is a pale yellowish brown, and of the lamina a beautiful pale greenish olive. I measured one noble specimen which had attained to the dimension of 32 feet, the stem of which was one inch in diameter at its thickest part, and the lamina about 2 feet in breadth. It is peculiarly a North American species; and although it is found as far south as Cape Cod, it is there much stunted in its growth, and very different in size and texture from specimens that are found on the northern shores. In Europe it is scarcely known to grow beyond the limits of the Arctic Sea, whence water-worn specimens occasionally reach the coasts of Scotland, and the north of Ireland. By the force of the waves it is frequently detached from its place of growth, and its hollow stem enables it to float easily upon the water. The greenish olive of its lamina shows that it requires a good deal of sunlight to bring it to perfection; that therefore it may get as much of this element of its life as possible, its long and hollow stem seems to have been provided. It is generally covered with parasites both vegetable and animal. Some of the more delicate deep sea plants will commonly be found growing upon the lower parts of its stem. At Peak's Island I found upon it the beautiful and delicate *Delessaria alata*, and frequently the stem was fringed along its whole length with *Ectocarpus granulosus.* Amateurs looking for deep sea plants, would do well to direct their attention to the stems of drifted individuals of this plant. The prevailing deep sea plants of this region are *Rodomela subfusca*, *Delesseria sinuosa*, *D. alata*, and *D. denticulata.* The two former in great abundance, the two latter are rather rare. *Enthora cristata*, the analogue of the European *Plocamium coccinium*, is among the most beautiful and common that is driven on shore from the deep. *Phyllophora membranifolia* is also found although by no means common. *Ptilota serrata* and *P. elegans* are frequently cast ashore in abundance. They inhabit the whole northern shore, and abound in the Gulf of St. Lawrence. Growing upon *Zostera marina* I also found *Ectocarpus siliculosus*, *Polysiphonia fibrillosa*, and *Punctaria tenuissima.*

In sandy bays, in water of from 1 to 4 fathoms deep, the curious cord-plant *Chorda filum* grows abundantly, and is from 30 to 40 feet long. It is a hollow and chambered plant, and in its young state is covered with green byssoid fibres. In the same category may also be noted the beautiful *Grinellea Americana*, frequently found on this coast, the analogue of the brilliant *Wormskioldia sanguinea* of Europe. It is peculiarly American, and grows abundantly in Long Island Sound, and New York Harbour.

Other plants might be added to these which we have noted, as inhabiting the various belts of the shore, and the deep waters of the North American coasts. These only occurred to me in my investigations at Peak's Island. Were however these zones of distribution to be permanently maintained, in works on the marine plants, they would greatly facilitate the work of collecting. Further researches would increase the number of plants which make their special homes in each, and would enable us to determine the habits of growth of those species whose special homes we have succeeded in localising. It would further be interesting to trace the *deep sea* limits of the various plants on this coast, after the manner of Forbes' researches in the Mediterranean. Little or nothing has yet been done in this branch of plant distribution in this country. The difficulties attending such investigations, on the boisterous and rocky coast of Eastern America, are very great, but it is to be hoped that some of the zealous botanists of America, with means and leisure at command, may turn their attention to this interesting department as their special study.

To sum up our work, we present the following classification of the plants noted in the several zones.

I. The plants found in the Drift Zone are a collection of all kinds.

II. The plants in the Ulva Zone are:—

Ulva *latissima.*
Enteromorpha *intestinalis.*
" *compressa.*
" *clathrata.*
" *Hopkirkii.*
Cladophora *rupestris.*
" *uncialis.*
" *flexuosa.*

Chætomorpha *litorea.*
Hormotrichum *Younganum.*
Fucus *Balticus.*

III. The plants in the Fucus Zone are:—

(1) Fucus *nodosus.*
(2) " *vesiculosus.*
(3) " *furcatus.*
Asperococcus *sinuosus.*
Chordaria *flagelliformis.*
Ectocarpus *siliculosus.*
Elachista *fucicola.*
Rhodomela *subfusca.*
Corallina *officinalis.*
Rhodymenia *palmata.*
Hypnea *musciformis.*
Cystoclonium *purpurascens.*
Gigartina *tenax?*
" *mamillosa.*
Halosaccion *ramentaceum.*
Furcellaria *fastigiata.*
Ceramium *rubrum.*
" *fastigiatum.*
Porphyra *laciniata.*
Chadophora *rupestris.*
Chætomorpha *melagonium.*

IV. The plants of the Lammaria Zone are:—

Agarum *Turneri.*
Alaria *esculenta.*
Laminaria *digitata.*
" *saccharina.*
" *Fascia.*
" *Phyllitis.*
" *dermatodea.*

V. The plants of the Chondrus Zone are:—

Chondrus *crispus.*
Laminariæ.

VI. The plants of the Deep Sea Zone are:

Laminaria *longicrucis.*
Punctaria *tenuissima.*
Ectocarpus *granulosus.*

Euthora *cristata.*
Ptilota *serrata.*
" *elegans.*
Polysiphonia *fibrillosa.*
Phyllophora *membranifolia.*
Delesseria *sinuosa.*
" *alata.*
" *denticulata.*
Zostera *marina.*

ARTICLE IV.—*Contributions to Meteorology for the year* 1861 *from observations taken at Isle-Jesus Canada East.* By Charles Smallwood, M. D. LL. D. Professor of Meteorology in the University of McGill College Montreal.

The following observations are a continuation of the Annual Report of the results of the observations taken at the Observatory. The means are reduced from tri-daily observations taken at 6 a. m., 2 p. m. and 10 p. m. The whole of the observations are all reduced to the usual standards, and the necessary corrections depending upon any peculiar construction of the instruments have been applied. It may be further stated, that the instruments are in the same position in which they have stood during a long series of years, and they are all subjected, at short intervals of time, to certain manipulations and corrections, so as to secure, as far as possible, accuracy; many of them are self-registering, and every means have been adopted to prevent either terrestrial, zenith or solar radiation on the bulbs of the thermometers; extra hours are set apart for observing any unusual phenomena, and a more particular attention has been directed to every sudden and great fall in the barometric column as indicating any unusual atmospheric wave, and also on the sudden fall of the thermometer indicating any extreme degree of cold as during our "*cold terms*," for the purpose of comparing observations here with those taken in any distant part of the world, and which may have a bearing on the theory of the formation of storms.

A seismometer has been added to the other instruments for the purpose of ascertaining the direction and amount of elevation of the earthquake wave. The more than usual frequency of late of earthquakes in this neighbourhood has led to the placing of the seismometer, so as to indicate and to estimate any such interesting phenomena.

Barometer.—The highest reading of the barometer during the year occurred at 9.30 p. m. on the evening of the 23rd of January, and indicated 30.687 inches; the lowest reading occurred on the 27th day of May at 1. 45 p. m. and indicated 28.883 inches, giving a yearly range of 1.804 inches; several sudden and great changes occurred during the year both with a rising and with a falling column. The first remarkable wave was on the 4th of March, when a very sudden fall took place; at 6 a.m. the barometer stood at 30.454 inches, and it fell in 24 hours 0.780 of an inch and continued falling until 2 p. m. of the 6th day when it attained a *minimum* of 29.450 inches; it then continued to rise, and at 10. p. m. the 7th day attained a height of 30.398 inches, showing a sudden rise of 0.948 of an inch. On the 15th of March a rise of 0.342 of an inch took place in 8 hours, and a like sudden rise occurred on the 30th day of 1.230 inches in 24 hours. Another sudden rise took place on the 28th of September at 6 a. m; the mercurial column indicated 29.276 inches, and in 24 hours it rose to 29.999 inches, showing a rise of 0.623 of an inch, and it continued rising until it attained a maximum of 30.315 inches; another sudden depression of 0.200 of an inch in 8 hours occurred on the 22nd of October, and a corresponding rise on the 24th day, also in 8 hours, of 0.409 of an inch. In November the mercury was as usual subjected to several fluctuations; the highest crest of the wave occurred on the 1st, 10th, and 20th days, and a corresponding trough took place on the 3rd, 16th, 24th and 30th days. In December, from the 12th to the 21st day, the mercurial column indicated great fluctuations, falling from 30.341 inches, to 29.746 inches, rising again to 30.137 inches and then again falling to 29.600 inches and again rising to 30.191 inches, again falling to 29.611 inches and attaining on the 21st a maximum of 30.269 inches; a sudden rise occurred on the 27th day, the column rising 0.293 of an inch in 8 hours. The mean barometric pressure for the year was 29.737 inches, showing a decrease of 0.046 of an inch compared with the mean of last year, but an increase of 0.061 of an inch when compared with a series of years. The following tables show the mean reading of each month and also the monthly range of the barometer in inches; the mean yearly range was 1.093 inches.

Monthly Means.

	Inches.		Inches.		Inches.
January.....	29.983	May........	29.721	September..	29.849
February...	29.750	June.......	29.720	October.,..	29.876
March	29.878	July	29.734	November...	29.714
April......	29.882	August.....	29.353	December...	29.892

Monthly Range.

	Inches.		Inches.		Inches.
January....	1.350	May	1.349	September..	1.023
February...	1.484	June.......	0.815	October....	1.014
March.....	1.401	July	0.637	November..	0.902
April......	1.381	August.....	0.770	December ..	0.994

The lowest range (or the least difference) was in July, and this has held good for a series of years. January for a long period shows the greatest range, but the month of February 1861 shows a greater range than January; the mean range for a series of years has been found to be 1.032 inches, which is 0.060 of an inch less than the yearly range of 1861. January shows the highest mean of the year and June the lowest. The mean reading of the barometer for the Winter Quarter was 29.883 inches, for the Spring Quarter 29.827 inches, for the Summer Quarter 29.769 inches, and for the Autumnal Quarter 29.813 inches.

Thermometer.—The mean temperature of the air for this year varies but very slightly from the mean temperature of a series of years, but the mean temperature indicated 1°89 degrees less than the mean temperature of last year (1860), and 0°16 of a degree only more than the mean annual temperature of a long series of years; the mean temperature for the year 1861 being 41°72. The highest reading was on the 9th of June at 3 p.m. and indicated 99°7 degrees; the lowest reading was at 6 a.m. on the morning of the 8th of February, and indicated—37°1 degrees (below zero), giving a yearly range or climatic difference of 136°8 degrees.

The warmest day of the year was the 10th of June, the mean temperature of the day was 81°1 degrees; at 11 a.m. the thermometer stood at 87°8 degrees, and at 3 p.m. 96°0 degrees, and at 4 p.m. 95°8 degrees; at 10 p.m. it stood at 76°7 degrees and it fell to 60°3 in the night, which was clear and calm, the terrestrial radiator indicated 57° degrees. The coldest day of the year was the 8th of February, the mean temperature indicated—28°5 degrees (below zero); below is a record of the cold term of January and February.

January 11, 1861.	6 a. m.	—23°.1	(below zero.)
	8 "	—23°.0	"
	9 "	—19°.1	"
	Noon	—17°.0	"
	2 p. m.	—10°.6	"
	4 "	—14°.8	"
	6 p. m.	—17°.0	"
	8 "	—20°.4	"
	10 "	—20°.6	"
January 12, 1861.	6 a. m.	—34°.9	"
	8 "	—34°.7	"
	10 "	—24°.6	"
	Noon	—14°.4	"
	2 p. m.	— 5°.1	"
	4 "	— 7°.3	"
	6 "	—14°.9	"
	8 "	—17°.4	"
	10 p. m	—17°.9	"
	Midnight	—20°.4	"
January 13, 1861.	6 a. m.	—26°.6	"
	8 "	—20°.8	"
	10 "	—12°.5	"
	Noon	— 5°.1	"
	2 p. m.	— 1°.6	"
	4 "	— 1°.0	"
	6 "	—11°.2	"
	8 "	—14°.3	"
	10 "	—16°.9	"
	Midnight	—19°.2	"
January 14, 1861.	6 a. m.	—13°.8	"
	8 "	—10°.4	"
	10 "	— 3°.1	"
	Noon	+ 2°.0	(above zero.)

The thermometer was 81 hours and 45 minutes below zero. The February cold term exceeded somewhat the above temperature, and was as follows :—

February 8, 1861.	10 p. m.	—21°.3	(below zero.)
	Midnight	—34°.6	"
	6 a. m	—37°.1	"
	9 "	—32°.1	"

Noon	—22°.2 (below zero.)	
2 p. m.	—14°.1	"
4 "	—19°.0	"
6 "	—20°.9	"
8 "	—19°.8	"
10 "	—19°.5	"
Midnight	—20°.4	"
6 a. m.	—24°.0	"
9 "	—20°.1	"
Noon	+1°1	"

The thermometer was for 56 hours below zero.

The following table shows the Mean Temperature for each month.

January....	10°.43	May.......	51°.86	September.	58°.06
February...	18°.25	June.......	65°.83	October.....	46°.64
March	21°.94	July.......	67°.66	November...	33°.60
April	38°.99	August.....	66°.84	December...	20°.54

July was the warmest month, but was 6°92 degrees colder than the mean temperature of July for a series of years.

The temperature of the Winter Quarter was 12°28 degrees, for the Spring Quarter 34°29 degrees, for the Summer Quarter 66°77 degrees, and for the Autumn Quarter 46°10 degrees; the temperature for the same period of last year (1860) was Winter Quarter 12°59 degrees, Spring Quarter 45°55 degrees, Summer Quarter 67°63 degrees, and Autumn Quarter 46°49 degrees. A thermometer sunk 18 inches in the ground showed a temperature of, in May 49°9, in June 59°8, in July 60°0, in August 66°0, in September 58°0, in October 53°0, and in November 47°4. The range of temperature or climatic difference exceeded by 19°2 degrees the range of 1860; below is a table of the climatic difference for each month of 1861:—

January.....	66°.5	May........	42°.9	September...	44°.6
February.....	90°.3	June	59°.6	October......	42°.4
March	65°.5	July........	51°.8	November....	28°.6
April.......	55°.3	August......	43°.3	December ...	56°.9

February shows an excessive range of temperature; this was owing to the excessive *cold term* of that month; November shows the least climatic change, and this is rather unusual for November; the range for November 1860 was 59°4 degrees, the mean range for November for a series of years being 61°1 degrees; the 1st frost of the Autumn occurred on the 5th of September; a sudden fall of temperature took place in March, at 2 p.m. on the 16th

day the thermometer stood at 36°7 degrees, and in 24 hours it fell to—5°0 degrees below zero, showing a difference of 41°7 degrees in that short period; this sudden change was accompanied by a rise in the barometer and a high wind from the west; December showed a *cold term* but of short duration; the following table shows the temperature :—

Dec. 20th, at 9 p.m.—	0.0	
Midnight—	10.0	(below zero)
21st, 6 a.m.—	10.1	"
11 " —	3.2	"
Noon—	0.5	"
0.20	0.0	"

This was the 1st cold term of the winter 1861-2.

Humidity of the Atmosphere.—The mean relative humidity for the year was 0.774, saturation being equal to 1.000.
The following table shows the relative humidity for each month :

January......	.752	May.........	.770	September...	.804
February....	.755	June........	.735	October.....	.843
March	.768	July.........	.765	November...	.787
April........	.780	August......	.736	December ...	.796

June was the driest month of the year, but July has been the driest for a series of years. Complete saturation occurred only once during the year.

Rain.—Fell on 106 days, amounting to 46.701 inches; it was raining 531 hours and 14 minutes, and was accompanied by thunder on 16 days; the number of days on which rain fell exceeded by 13 the number of days of rain of 1860, and by 112 hours 14 minutes, but was 5 days less than the number of rainy days in 1859, but exceeded by 33 days the amount of days of rain compared with a series of years; the amount of rain which fell in 1859 was 50.035 inches, and in 1860 was 48.132 inches, and the amount of rain in 1861 exceeded by 3.697 inches the average amount compared with a series of years; a very heavy rain storm occurred on the 27th May, it began at 4.25 p.m. from

	h.m.		Inches.
the E.N.E. and at	4.45	the fall registered	1.700
	4.50	(*wind veered to W.*)	2.066
	4.53		2.333
	4.55		2.433
	5.00		2.483
and ceased at	5.10	and equalled	2.486 inches,

which fell in 45 minutes. The Rivière des Prairies, a branch of the Ottawa, rose very high during May, and a like rise has not been witnessed since 1848.

The following table shows the monthly amount and the duration of fall:

	Amount.	Time.		Amount.	Time.
	Inches.	h. m.		Inches.	h. m.
January........	0.100	4.10	July...........	10.188	79.49
February.......	0.761	17.25	August.........	1.950	12.31
March.........	1.756	52.35	September......	4.816	66.50
April..........	2.921	60.42	October........	5.370	69.30
May...........	8.642	49.32	November......	1.023	32.52
June..........	4.868	56.18	December......	1.306	31.00

July shows a very large amount of rain but is not the greatest amount on record here for July, but exceeds by 4.456 inches the amount of last July (1860), but is less by 2.026 inches the amount of rain which fell in July 1859, which was the most rainy July on record here; this was accompanied by a very heavy storm and showed an amount of rain equal to 6.374 inches, and the rivers in this neighbourhood rose at this time nearly 2 feet; the rain storm lasted 45 hours and 40 minutes.

Thunder and lightning occurred on 16 days, the yearly mean for a series of years is 14; last year (1860) thunder only occurred on 11 days; there were 43 cloudless days only during the year 1861, the average for a series of years being 57. The prevailing clouds were *Cumuli Stratus* and a rather larger amount of *Cirri Stratus*, giving rise to haloes; and there were but 123 nights suitable for astronomical purposes; this is less by 20 than the number of nights in the year 1860. *Snow* fell on 45 days amounting to 99.53 inches; it was snowing 365 hours and 54 minutes, which is less by 1.77 inches the average amount for a series of years, but is 38.26 inches less than the amount of snow which fell in 1860, and is 40.57 inches less than the amount which fell in 1859. The last snow of the winter 1860-1 fell on the 17th of April, and the 1st snow of the autumn fell on the 24th October. Winter did not fairly set in until the 23rd of December.

Evaporation.—The amount of evaporation from the surface of water during the 6 months which are recorded is 16.90 inches, which is nearly 1 inch less than the mean amount; the amount of evaporation also from the surface of ice was somewhat less than the average.

The greatest intensity of the Sun's rays was 104°3 degrees, which is less by 6°3 degrees than the intensity for the year 1860, and is 12°7 degrees less than the intensity for the year 1859. *The lowest point of the terrestrial radiation*, was—39°4 degrees (below zero.)

Dew.—The yearly amount of dew was below the usual mean or average; an apparatus has been used for a short time for the purpose of ascertaining the hour at which dew begins to fall and when it ends, and also the amount, and it is believed will lead to some interesting results in this department of research; the apparatus is self-registering and leaves a permanent impression.

Wind.—The most prevalent wind during the year was the N. E. by E. and the least so E. by N.; the next in frequency was the W. and W. S. W. and a good deal of S. E. winds prevailed; below is a table of the amount of horizontal miles of wind for each month:

	Miles.		Miles.		Miles.
January...	6380.10	May......	4989.20	September.	3447.48
February..	5549.95	June......	5067.93	October...	3664.29
March....	5437.69	July......	4499.68	November.	4142.30
April.....	3565.12	August....	2736.05	December..	5816.99

giving a total for the year of 55296.78 miles linear, which is 11083.26 miles more than the amount for the year 1860; the mean velocity for the year was 6.312 miles per hour, which shows an increased velocity of 1.270 miles per hour for 1861 over that of 1860. June was the calmest month last year and indicated only 2905.36 miles; a tornado passed over Montreal on the 9th of July, but was little felt here; on the 10th of August a very heavy hail storm passed near this place over St. Laurent and Montreal, doing considerable damage to crops and buildings; there were several storms of wind during the year preceded by rain and a low barometer.

The Aurora Borealis, was visible at observation hour on 42 nights; a bright display with considerable magnetic disturbance occurred on the night of the 1st of September, the same period that the splendid display which caused so much sensation over the world occurred last year.

The Zodiacal Light was frequently seen; it was generally bright and well defined.

Solar and Lunar Halos have been more than usually frequent during the year. A remarkable solar halo occurred on the 12th of August, when the temperature had fallen considerably during

the night. The thermometer at 6 A.M. stood at 46°07 degrees. The terrestrial radiator had indicated a temperature of 41°03 degrees. The wind at 10 A.M., (mean local time) was from the N.E. by E., with a clear sky, from which time light *cirrus* clouds began to form in the higher region of the atmosphere, passing from W. to W.S.W., in a direction contrary to the lower current of wind (N.E. by E.) At 10h. 38m. a slight halo was seen round the sun, and at 10h. 45m. it presented a very rare and beautiful spectacle. The sun, bright and *white*, was in the centre of a halo or circle of 44 degrees in diameter, its lower or southern limb being about 37 degrees above the horizon ; this circle was a bright halo of light, white and bright at its outer edge, and which was shaded inwardly and towards the sun of a pale orange colour, and an occasional tint of blue and red ray nearly 2 degrees in breadth. Both the lower limbs of this halo on the edge next the sun were more broad than elsewhere, giving the appearance of a crescent on each side. This halo or bright circle was filled in as it were with a dark ground, consisting of *cirrus* clouds, which passed quickly and constantly across from a westerly direction.

Another circle of a white colour and less bright, was also seen. The circumference of the wheel was in the centre of the bright halo, or more properly in the sun itself; the ring extended beyond the zenith, and exceeded the brighter one considerably in diameter. Another smaller circle was enclosed between the bright northern limb of the halo and the last mentioned circle, which on approaching its periphery separated somewhat, and crossed each other from right to left, extending east and west for a short distance, and the breadth of these circles were from 1½ to 2 degrees.

Lower down, nearer the horizon, on either side of the halo, were arcs or broken portions of an imperfect circle, somewhat resembling inverted rainbows, with distinct prismatic colours which varied both in brightness and extent. These appearances decreased and ceased at 12h. 40m. P.M. The wind veered into the S.E. by E. with an increase of temperature and a cloudy sky. The following day at 11 A.M., another halo appeared round the sun, but unattended with any of the peculiar appearances as above noticed.

The other solar and lunar halos and coronæ, although more frequent than usual, offered no peculiarities.

Observations on the *Solar Spots* still form a part of the records at this place.

Ozone.—The observations have been continued by means of the calico ozoneometer, which is kept moving by clock work, so as to indicate the variable amount, and has furnished very interesting results, as also the action of the coloured rays of light and polarized light and its development.

Atmospheric Electricity.—The tri-daily observations have been taken with Pelletier's and Ramerhausen's apparatus as heretofore, but these observations are far too extended for a short notice.

Comets were seen, Thatcher's in May ; a bright one 30th June, and a smaller one, October.

Earthquakes.—A smart shock was felt on the 11th of July at 9 hours 3 minutes P.M., local time, it lasted for 20 seconds. The wave passed from N.N.W. to E., and another slight shock was felt in October. A register will for the future be kept in connexion with the seismometer.

The Lunar Eclipse of the 17th December was not seen, being obscured by clouds.

Crows (*Corvus corona*), first seen on the 27th of February. The song sparrow (*Fringilla melodia*), first heard 4th of April. Wild geese (*Anser Canadensis*), first seen flying W. on the 29th April. Swallows (*Hirundo rufa*), first seen 23rd April. Frogs (*Rana fontanalis*), first heard the 24th day. Shad (*Alosa prostabilis*), first caught 30th May. Fire flies (*Lampyris corusca*), first seen 19th June. Snow birds (*Plectrophanes nivalis*), first seen 17th of November. Crows left on the 7th day of November.

Currants and gooseberries in leaf on the 16th May. Wild strawberries in flower, 24th. Dandelion in flower, 23rd. Currants and gooseberries in blossom on the 24th. Lilac in blossom on the 3rd of June. Apples on the 4th. Chokecherries in blossom on the 6th of June.

The magnetic observations carried on at this Observatory, will form a separate paper for future publication.

Observatory, Isle Jesus, 22nd January, 1862.

ARTICLE IV.—*On the Mammals and Birds of the District of Montreal.* By ARCHIBALD HALL, M.D., L.R.C.S.E.

(*Continued from page* 309, *Vol. VI.*)

BIRDS.

Species that winter in the district of Montreal, or that during that period visit it.

Falco Palumbarius.	Pyrrhula Enucleator.
Strix Virginianus.	Strix Funerea.
" Cinerea.	" Nyctea.
" Nebulosa.	" Otus.
Parus Palustris.	" Tengmalmi.
Corvus Corax.	Emberiza Nivalis.
" Corone.	Picus Villosus.
" Canadensis.	" Pileatus.
Picus Pubescens.	Tetrao Umbellus.
" Tridactylus.	" Lagopus.
Tetrao Canadensis.	Bombycilla Garrula.
Emberiza Lapponica.	Linaria Minor, probably.

Table giving a comparative view of the number and colour of the eggs of the species that incubate in the district of Montreal as far as ascertained.

Genus.	Species.	Colour of Eggs.
Falco	F. Sparverius	4 to 5 brownish yellow, mottled brown.
	F. Columbarius	2 to 4 white, mottled with red.
Aquila	F. Chrysaetos	2 to 3 dirty white, spotted red.
Halietos	F. Leucocephalus	1 to 2 white.
	F. Halietos	2 to 4 cream yellow, blotched with red.
Astur	F. Palumbarius	2 to 4 blueish white, mottled with brown.
	F. Fuscus	4 dirty white, blotched with red.
	F. Cooperii	Unknown.
Buteo	F. Lagopus	4 white, mottled with red.
	F. Buteodis	2 to 4 waved with green, spotted with yellow on a white ground.
	F. Borealis	Unknown.
	F. Hyemalis	Unknown.
	F. Cyaneus	3 to 5 plain blueish white.
Surnia	Strix Funerea	2 white.
	" Nyctea	2 white.
	" Nævia	4 to 6 white.
Bubo	" Virginianus	2 to 4 white.
	" Cinerea	2 white, mottled with blackish brown.
Ulula	" Otus	4 to 5 white.
	" Brachyotus	2 to 4 white.
	" Nebulosa	4 to 5 white.
	" Tengmalmi	2 white.
	" Acadica	Unknown.
	" Dalhousii	Unknown.
Lanius	Lanius Excubitor	6 cinereous white, mottled at the larger end with rufous.

Genus.	Species.	Colour of Eggs.
Muscicapa.....	Muscicapa Tyrannus	5 yellowish white, blotched with brown.
	" Crinata..	4 dull white blotched and mottled with purple.
Muscipeta.....	Musicipeta Nunceola	5 pure white.
	" Virens..	3 to 4 cream colour, spotted and blotched at larger end with lilac and brown.
	" Querula.	5 white.
Setophaga.......	Setophaga Ruticilla	3 to 4 cream white, mottled with yellowish brown.
Vireo.........	Vireo Flavifrons ...	4 white, mottled with light and dark brown at larger end.
	" Olivaceus ...	3 to 4 white, mottled with light and dark brown.
	" Gilvus	3 to 4 white, spotted blackish purple at the larger end.
Sylvia	Sylvia Citrinella...	4 dull white, mottled with brown.
	" Varia........	5 " " "
	" Coronata	Unknown.
	" Pennsylvanica	"
	" Maculosa	"
	" Pardulina....	"
	" Philadelphica.	"
	" Blackburnica .	"
	" Virens	4 flesh colour, mottled with purple and brown.
	" Striata.......	4 to 5 white, mottled with brown.
	" Castanea.....	Unknown.
	" Pinus........	4 greenish white, mottled with pale brown and light purple.
Regulus	Regulus Calendulus	Unknown.
	" Cristatus..	6 to 12 yellowish white, spotted with red.
Troglotides....	Troglotides Fulvus.	10 to 18 white, with a few reddish spots.
	" Europæus	10 to 18 white, spotted with red.
Anthus	Anthus Spinoletta..	4 to 5 sullied white, mottled with brown.
Ampelis	Ampelis Sialia.....	5 to 6 pale blue.
Bombycilla	Bombycilla Garrula	Unknown.
	" Carolinensis	4 to 5 white, spotted black at the larger end.
Turdus	Turdus Migratorius.	5 blueish green.
	" Rufus	5 greenish white, spotted brown.
	" Felivox	4 to 5 emerald green.
	" Minor......	4 to 5 greenish blue.
	" Mustelinus .	4 to 5 emerald green.
	" Melodius ...	4 to 5 greenish blue.
	" Noveboracensis	4 to 5 flesh colour, spotted dark at larger end.
	" Aurocapillus..	4 to 5 white, mottled reddish brown.
Tanagra	Tanagra Rubra....	3 to 4 dull blue, mottled brownish purple at larger end.

Genus.	Species.	Colour of Eggs.
Quisculus	Quisculus Versicolor	5 to 6 dull green, spotted with dark olive.
	" Baritus	5 dark coloured, spotted dusky.
	" Ferrugineus	5 dusky, spotted black.
Oreolus	Oreolus Baltimorus.	4 to 5 blueish white spotted and streaked with dark brown.
Hirundo	Hirundo Purpurea..	4 to 6 white.
	" Rufa	4 white, spotted brown.
	" Bicolor ...	4 to 5 white.
	" Fulva	4 white, spotted dusky brown.
Cypsilus	Cypsilus Pelasgius.	4 white.
Caprimulgus ..	Caprimu's Vociferus	2 blueish white, blotched with dark olive.
	" Virginianus.	2 blueish white, mottled with umber brown.
Alauda..........	Alauda Alpestris*..	Unknown.
Parus	Parus Palustris	6 to 12 white, spotted reddish brown.
Emberiza	Emberiza Nivalis...	5 whitish, mottled brown & grey.
	" Lapponica*	5 to 6 yellowish rusty, clouded with brown.
Fringilla	Fringilla Cyanea...	5 greenish white.
	" Nivalis	3 to 5 pale green, spotted cinereous.
	" Pennsylvanica.	Unknown.
	" Melodia	4 to 5 greenish white, mottled brown.
	" Canadensis ...	5 pale brown, mottled with dark brown.
	" Leucophrys ...	4 to 5 chocolate or dusky colour.
	" Vocalis	4 to 5 greenish blue,mottled with dark and light brown.
	" Graminea	4 to 5 whitish, mottled and blotched with reddish brown at larger end.
	" Tristis	3 to 5 white, mottled lavender, purple and yellowish brown at larger end.
	" Pinus	Unknown.
	" Linaria	5 blueish white, spotted red.
	" Iliaca	5 mountain green,mottled brown
	" Ludoviciana ..	4 to 5 white, spotted brown.
	" Purpurea	Unknown.
Pyrrhula........	Pyrrhula Enucleator	4 to 5 white ?
Icterus	Icterus Phœniceus..	3 to 5 blueish white, streaked purple and dark brown.
	" Agripennis ..	5 to 6 olivaceous white, blotched with lilac and rufous brown at larger end.
	" Pecoris.....	3 to 5 greenish white, spotted olive brown.
Sturnus	Stur'usLudoviciana*	4 to 5 white, tinged with blue, spotted reddish brown.

* It is doubtful if those marked with au asteric breed in the district. It is not improbable that they do so occasionally.

Genus.	Species.	Colour of Eggs.
Corvus	Corvus Corax	5 to 6 muddy blueish green, spotted with olive brown.
	" Corone	2 white.
	" Cristatus	5 dull olive, spotted brown.
	" Canadensis.	3 to 4 blue.
Certhia	Certhia Familiaris	5 dull white, spotted brown.
		Unknown.
Sitta	Sitta Carolinensis	7 or more cinereous spotted reddish yellow, and streaked dark brown.
	" Canadensis	
Trochilus	Trochilus Colubris.	2 white.
Alcedo	Alcedo Alcyon	6 white.
Picus	Picus Auratus	6 white.
	" Erythrocephalus	6 white, spotted red?
	" Varius	4 white.
	" Villosus	5 white.
	" Pubescens	6 white.
	" Pileatus	6 white.
	" Tridactylus	4 to 5 white.
Cuculus	Cuculus Dominicus.	3 to 5 blueish green.
Tetrao	Tetrao Umbellus	10 to 15 dull yellow.
	" Canadensis	5 white, varied yellow & black.
Lagopus	" Lagopus	7 to 15 rufous yellow, spotted with reddish black.
Columba	Columba Migratoria	2 white, "one of them abortive." Wilson.
	" Carolinensis*	2 white, breeds in the Southern States.
Charadrius	Charadrius Vociferus	4 yellowish cream colour, spotted black.
	" Pluvialis*	4 to 5 pale olive, spotted with black.
	" Semipalmatus*	4 dark coloured, spotted with black.
Vanellus	Vanellus Helveticus	4 cream colour, spotted and blotched with light and purplish brown.
Ardea	Ardea Herodias	4 greenish blue.
Botaurus	" Discors	4 greenish blue.
	" Lentiginosa	4 cinereous green.
	" Exilis	Unknown, but if resembling the European species—white.
Calidris	Calidris Arenaria*	4 dusky, spotted with black.
Strepsilus	Strepsilus Interpres*	4 olive green, spotted with brown.
Numenius	Numenius Borealis*	4 greenish spotted with light umber brown.
	" Longirostris	4 cream colour, spotted brown?
	" Hudsonius	4 dark blueish grey, spotted with black or dark brown.
Scolopax	Scolopax Grisea	Unknown.
	" Wilsonii	4 olivaceous, spotted with brown.
	" Minor	4 olivaceous white, blotched with yellowish brown.
Limosa	Limosa Fedoa*	Unknown.
	" Hudsonica*.	4 dark olive, spotted with pale brown.

Genus.	Species.	Colour of Eggs.
Phaleropus	Phale. Hyperboreus*	3 to 4 olivaceous, thickly spotted with blackish brown.
Tringa........	Tringa Alpina*....	4 oil green, spotted liver brown
	" Pectoralis..	Unknown.
	" Rufescens ..	Unknown.
	" Pusilla	Unknown.
	" Rufa*......	4 dun colour, spotted red.
	" Semipalmata*	4 to 5 white spotted with black.
Totanus.......	Totanus Vociferus..	Uncertain or unknown, (4 dark colour, spotted black. "Hutchins.")
	" Flavipes......	Unknown.
	" Chloropygius.	Unknown.
	" Macularius ...	4 greyish yellow, speckled with dark brown.
Rallus	Rallus Virginianus.	6 to 10 cream colour, sprinkled with brownish red, and pale purple.
	" Carolinus.....	Uncertain.
	" Noveboracensis	10 to 16 white.
Fulica	Fulica Americana..	Uncertain.
Colymbus	Colymbus Glacialis*	3 to 4 smokey olive, blotched with umber brown.
	" Septemtrionalis*	2 pale oil green colour.
Podiceps	Podiceps Cornutus.	3 to 4 white, spotted brown.
	" Cristatus ..	3 to 4 greenish white, waved with dark brown.
	" Minor	5 to 6 dirty white.
	" Rubricollis..	3 to 4 greenish white, sullied with yellowish brown.
	" Carolinensis	Unknown.
Sterna	Sterna Hirundo	3 to 4 dull yellowish, or pale whitish olive, blotched with dark brown.
	" Arctica*	2 to 3 light yellowish brown, or blueish grey, spotted with brown.
	" Nigra........	3 to 4 olive brown, mottled brown and black.
Larus	Larus Atricilla....	3 olive grey, spotted pale purple and dilute brown.
	" Tridactylus..	3 olivaceous white, spotted light and dark grey.
	" Canus*	3 "blueish ochraceous," spotted cinereous and blackish.
	" Fuscus	2 olive brown or grey, blotched with dusky.
	" Argentatus *	2 to 3 olivaceous, spotted with dark cinereous.
	" Glaucus*	3 pale purplish grey, spotted with umber brown, and pale purple.
Anser	Anser Canadensis..	6 to 7 greenish white.
	" Hyperboreus*	yellowish white.
	" Leucopsis* ..	Uncertain as to this country.
	" Bernicla* ...	Uncertain.

Genus.	Species.	Colour of eggs.
Cygnus Ferus...	Cygnus Ferus.....	5 to 7 olivaceous green & rough.
Anas	Anas Boschas......	10 to 18 blueish white.
	" Clypeata.....	12 to 14 pale greenish yellow.
	" Strepera	8 to 9 greenish grey.
	" Obscura	8 to 15 white.
	" Discors	dirty white, spotted with brown.
	" Crecca	
	" Americana ...	6 to 8.
	" Acuta	8 to 9 greenish blue.
	" Sponsa	12 to 13 yellowish white.
Clangula	" Albeola......	Unknown.
	" Clangula	7 to 10 white.
	" Hystrionica ..	12 to 14 white.
Oidemia	" Perspicillata*.	4 to 6 white.
	" Fusca*	8 to 10 white.
Harilda	" Glacialis	5 pale greenish grey.
Fuligula	" Ferina........	12 to 13 greenish white.
	" Marila........	Unknown.
	" Rufitorquis ...	Unknown.
Mergus	Mergus Serrator.....	8 to 13 blueish white.
	" Cucullatus .	6 white.
	" Merganser..	10 to 14 white.

TABLE shewing the species met with in the District of Montreal, their extreme Northern range, whether migratory or resident in the District, their winter quarters, and the month of their arrival at, and departure from the District.

No.	Specific names.		Extr of N. Lat.	Resid. or Migrat'ry	Winter quarters.	Date of arrival	Date of depart
1	Falco Sparverius...	Common.	56	Migr'y	W. I. Mex. &c	Mar.	Sep.
2	" Columbarius .	Scarce.	66	Migr'y	Mexico.	April	Sep.
3	" Chrysaetos ...	Scarce.	66	Migr'y	....	April	Nov.
4	" Leucocephalus	Scarce.	62	Migr'y	South. States.	April	Nov.
5	" Halietos	Common.	60	Migr'y	Tropics.	April	Nov.
6	" Palumbarius .	Common:	68	Resid.	Fur Countries		
7	" Insignatus ...	Rare.		Migr'y			
8	" Fuscus	Common.	49	Migr'y	South. States.	April	Nov.
9	" Cooperii	Rare.	68	Migr'y			
10	" Lagopus	Common.	58	Migr'y	Mid. States.	Mar.	Dec.
11	" Buteodis	Common.	55	Migr'y	S. California	Mar.	Nov.
12	" Borealis	Common.		Migr'y	South. States.	Mar.	Nov.
13	" Hyemalis	Scarce.	68	Migr'y	South. States.	May.	Oct.
14	" Cyaneus	Rare.	68	Resid.	South. States.		
15	Strix Funerea	Common.	75	Resid.	....		
16	" Nyctea	Common.		Migr'y			
17	" Nævia........	Scarce.	68	Resid.	....	April	Nov.
18	" Virginianus....	Common.	68	Resid.			
19	" Cinerea.......	Common.	60	Resid.			
20	" Otus	Common.	67	Migr'y			
21	" Brachyotus....	Common.	53	Resid.	....	Mar.	Dec.
22	" Nebulosa	Common.	60	Resid.			
23	" Tengmalmi ...	Scarce.	50	Migr'y			
24	" Acadica	Scarce.		Migr'y	North. States.	Mar.	Dec.
25	" Dalhousii......	Rare.	54	Migr'y	North. States.	Mar.	Dec.
26	Lanius Excubitor ..	Common.	57	Migr'y	....	April	Nov.
27	Muscicapa Tyrannus	Common.		Migr'y	Tropics.	June.	Sep.
28	" Crinata .	Common.		Migr'y	Tropics.	June.	Sep.
29	Muscipeta Nunciola.	Common.		Migr'y	South. States.	May.	Oct.
30	" Virens ...	Common.		Migr'y	South. States.	May.	Oct.
31	" Querula .	Scarce.	58	Migr'y	South. States.	May.	Oct.
32	Setophaga Ruticilia.	Common.		Migr'y	United States.	May.	Sep.
33	Vireo Flavifrons ...	Scarce.	55	Migr'y	Tropics.	May.	Sep.
34	" Olivaceus....	Common.		Migr'y	South. States.	May.	Sep.
35	" Gilvus	Rare.	68	Migr'y	South. States.	June.	Sep.
36	Sylvia Citrinella...	Common.		Migr'y	Tropics.	May.	Sep.
37	" Varia	Common.	56	Migr'y	"	May.	Sep.
38	" Coronata ...	Common.		Migr'y	South. States.	June.	Sep.
39	" Pennsylvanica	Common.	55	Migr'y	South. States.	May.	Sep.
40	" Maculosa	Common.		Migr'y	Tropics.	June.	Sep.
41	" Pardulina ...	Common.		Migr'y	"	June.	Sep.
42	" Philadelphica.	Scarce.		Migr'y	"	June.	Sep.
43	" Blackburnica.	Rare.		Migr'y	"	June.	Sep.
44	" Virens	Scarce.	54	Migr'y	"	June.	Sep.
45	" Striata	Common.		Migr'y	"	May.	Sep.
46	" Castanea	Scarce.		Migr'y	"	May.	Sep.
47	" Pinus	Common.		Migr'y	"	May.	Sep.
48	" Rubricapilla .	Rare.		Migr'y	South. States.	June.	Sep.

No.	Specific names.		Extr of N. Lat.	Resid. or Mi-grat'ry	Winter quar-ters.	Date of arrival	Date of depart
49	Regulus Calendulus	Scarce.		Migr' y	Tropics.	May.	Oct.
50	Regulus Cristatus..	Scarce.		Migr' y	"	May.	Oct.
51	Troglotides Fulvus.	Common.		Migr' y	South. States.	May.	Aug.
52	" Europæus	Scarce.		Migr' y	South. States.	May.	Aug.
53	Anthus Spiuoletta..	Scarce.	60	Migr' y	South. States.	Sep.	Nov.
54	Coccyzus America's	Scarce.		Migr' y	South. States.	June.	Sep.
55	" Canadensis .	Scarce.		Migr' y	South. States.	June.	Sep.
56	Ampelis Sialia	Common.	65	Migr' y	South. States.	May.	Sep.
57	Bombycilla Garrula	Scarce.	67	Migr' y	Mex., Tropics	Jan.	Feb.
58	" Carolinensis	Common.	56	Migr' y	Mex., Tropics	A&M	Sep.
59	Turdus Migratorius.	Common.	67	Migr' y	South. States.	May.	Oct.
60	" Rufus......	Common.	54	Migr' y	South. States.	June.	Sep.
61	" Felivox....	Common.	54	Migr' y	Florida.	May.	Oct.
62	" Minor	Common.	54	Migr' y	South. States.	May.	Sep.
63	" Mustelinus ..	Scarce.		Migr' y	....	May.	Oct.
64	" Melodius ...	Common.		Migr' y	....	May.	Sep.
65	" Noveboracensis	Rare.		Migr' y	....	May.	Sep.
66	" Aurocapillus ..	Rare.		Migr' y	....	May.	Sep.
67	Tanagra Rubra.....	Common.	49	Migr' y	....	June.	Sep.
68	Quisculus Versicolor	Common.	57	Migr' y	Flor., Brazil.	June.	Sep.
69	" Baritus..	Common.		Migr' y	South. States.	May.	Oct.
70	" Ferrugineus	Scarce.	68	Migr' y	South. States.	June.	Sep.
71	Oreolus Baltimorus.	Common.	55	Migr' y	Tropics.	May.	Sep.
72	Hirundo Purpurea..	Common.	67	Migr' y	Brazil.	May.	Aug.
73	" Rufa......	Common.	68	Migr' y	Tropics.	May.	Sep.
74	" Bicolor	Common.	60	Migr' y	Louisiana.	April	Aug.
75	" Fulva.....	Common.	67	Migr' y	....	May.	Aug.
76	Cypsilus Pelasgius.	Common.	49	Migr' y	....	May.	Sep.
77	Caprimul's Vociferus	Common.	48	Migr' y	S. America.	May.	Sep.
78	" Virginianus.	Scarce.	68	Migr' y	S. America.	May.	Sep.
79	Alauda Alpestris...	Scarce.	69	Migr' y	....	Sep.	Nov.
80	Parus Palustris....	Common.	65	Resid.	....		
81	Emberiza Nivalis...	Common.	76	M. & R	....	Nov.	May.
82	" Lapponica	Rare.	70	Migr' y	....	April	
83	Fringilla Cyanea...	Common.		Migr' y	Mexico.	June.	Sep.
84	" Nivalis ...	Common.			....	April	Oct.
85	" Pennsylvanicus	Common.	57	Migr' y	....	Sep.	Nov.
86	" Melodia	Common.		Migr' y	South. States.	April	Sep.
87	" Canadensis ...	Common.	60	Migr' y	California	May.	Sep.
88	" Leucophrys ...	Rare.	68	Migr' y	North. States.	June.	Sep.
89	" Graminea	Common.	57	Migr' y	M. & S. States	April	Oct.
90	" Tristis........	Common.	60	Migr' y	Mexico.	May.	Nov.
91	" Pinus	Rare.		Migr' y	....	May.	Sep.
92	" Linaria.......	Scarce.	68	M. & R	Fur Countries	May.	Sep.
93	" Iliaca.........	Rare.	68	Migr' y	M. & S. States	May.	Sep.
94	" Ludoviciana ..	Scarce.	55	Migr' y	M. & S. States	May.	Sep.
95	" Purpurea	Common.	55	Migr' y	South. States.	April	Sep.
96	" Socialis.......	Common.	60	Migr' y	Fur Countries	Dec.	Mar.
97	Pyrrhula Enucleator	Common.	57	Migr' y	Mexico, &c.	May.	Sep.
98	Icterus Phœniceus..	Common.		Migr' y	South. States.	April	Sep.
99	" Agripennis..	Common.	54	Migr' y	Mexico.	May.	Sep.
100	" Pecoris	Scarce.	56	Migr' y	Mexico.	May.	Sep.

* Observed only in cold winters, when a scarcity of food drives them south.

No.	Specific names.		Extr of N. Lat.	Resid. or Migrat'ry	Winter quarters.	Date of arrival	Date of depart
101	Sturnus Ludoviciana	Rare.	56	Migr' y	South. States.	May.	Sep.
102	Corvus Corax.....	Rare.	75	Resid.	Fur Countries		
103	" Corone* ...	Common.	55	M. & R	Fur Countries		
104	" Cristatus...	Common.	56	Migr' y	M. & S. States	May.	Oct.
105	Corvus Canadensis*	Common.	65	Resid.	Fur Countries		
106	Certhia Familiaris..	Scarce.		Migr' y	South. States.	May	Sep.
107	Sitta Carolinensis..	Scarce.		Migr' y	Mexico.	April	Sep.
108	" Canadensis ..	Common.		Migr' y	South. States.	April	Sep.
109	Trochilus Colubris.	Common.	57	Migr' y	Mexico.	May.	Aug.
110	Alcedo Alcyon....	Common.	67	Migr' y	Mex., Tropics	May.	Sep.
111	Picus Auratus.....	Common.	61	Migr' y	South. States.	May.	Sep.
112	" Erythrocephalus	Common.	50	Migr' y	South. States.	May.	Sep.
113	" Varius	Scarce.	61	Migr' y	S. States, Mex	May.	Oct.
114	" Villosus	Common.	63	Resid.			
115	" Pubescens	Common.	58	Resid.			
116	" Pileatus	Scarce.	63	Resid.			
117	" Tridactylus	Scarce.	68	Resid.			
118	Cuculus Dominicus.	Scarce.		Migr' y	Tropical Am.	May.	Aug.
119	Tetrao Umbellus...	Common.	56	Resid.			
120	" Canadensis .	Common.	68	Resid.			
121	" Lagopus ...	Rare.	70	Resid.			
122	Columba Migratoria	Common.	62	Migr' y	South. States.	May.	Sep.
123	" Carolinensis†	Rare.		Migr' y			
124	Charadrius Pluvialis	Common.	75	Migr' y	Tropics.	May.	Nov.
125	" Vociferus	Scarce.	56	Migr' y	California.	May.	Nov.
126	" Semipalmatus	Scarce.	70	Migr' y	South. States.	May.	Nov.
127	Vanellus Helveticus	Rare.	70	Migr' y	South. States.	April	Nov.
128	Ardea Herodias....	Scarce.	50	Migr' y	M. & S. States	May.	Sep.
129	" Discors	Common.		Migr' y	South. States.	May.	Oct.
130	" Lentiginosa .	Common.	58	Migr' y	South. States.	May.	Oct.
131	" Exilis	Rare.		Migr' y	....	May.	Sep.
132	Calidris Arenaria..	Common.	60	Migr' y	M. & S. States	May.	Sep.
133	Strepsilus Interpres.	Scarce.	75	Migr' y	Tropics.	May.	Oct.
134	Numenius Borealis.	Scarce.	70	Migr' y	"	May.	Nov.
135	" Longirostris	Rare.	52	Migr' y	"	May.	Nov.
136	" Hudsonius .	Scarce.	60	Migr' y	"	May.	Nov.
137	Scolopax Grisea...	Rare.		Migr' y	S. States, Tr's	May.	Sep.
138	" Wilsonii..	Common.	55	Migr' y	South. States.	April	Nov.
139	" Minor‡ ..	Common.		Migr' y	South. States.	Mar.	Oct.
140	Limosa Fedoa.....	Rare.	68	Migr' y	S. States, Tr's	May.	Nov.
141	" Hudsonica.	Scarce.	68	Migr' y	S. States, Tr's	May.	Nov.
142	Phaleropus Hyperbo.	Scarce.	75	Migr' y	....	A.,M.	Nov.
143	Tringa Alpina.....	Common.	75	Migr' y	South. States.	April	Nov.
144	" Pectoralis ..	Scarce.		Migr' y	....	April	Oct.
145	" Rufescens ..	Rare.		Migr' y	....	April	Oct.
146	" Pusilla.....	Common.	68	Migr' y	S. States, Tr's	A.,M.	Nov.
147	" Rufa.......	Common.	75	Migr' y	S. States, Tr's	A.,M.	Nov.
148	" Semipalmata	Common.	60	Migr' y	....	April	Nov.
149	Phalacrocorax Dilop	Scarce.	68	Migr' y	Mid. States.	April	Dec.

* Has been frequently observed wintering in the District.

† One specimen killed in June, 1838.

‡ Leave about the 20th October, but have been seen in mild autumns as late as the 10th of December.

No.	Specific Names.		Extr of N. Lat.	Resid. or Migrat'ry	Winter quarters.	Date of arrival	Date of depart
150	Totanus Vociferus..	Common.	60	Migr'y	S. States, Tr's	April	Oct.
151	" Flavipes ..	Common.	70	Migr'y	S. States, Tr's	A.,M.	Oct.
152	" Chloropygius	Scarce.	68	Migr'y	United States	A.,M.	Oct.
153	" Macularius..	Common.		Migr'y	United States	April	Oct.
154	Rallus Virginianus.	Common.		Migr'y	South. States.	May.	Sep.
155	Rallus Carolinus...	Common.	62	Migr'y	Tropics.	May.	Sep.
156	" Noveboracensis	Rare.	57	Migr'y	Tropics.	May.	Sep.
157	Fulica Americana..	Scarce.	55	Migr'y	California.	May.	Sep.
158	Colymbus Glacialis.	Common.	70	Migr'y	Mid'le States.	April	Dec.
159	" Septemtrionalis.	Rare.	74	Migr'y	United States.	April	Dec.
160	Podiceps Cornutus .	Scarce.	68	Migr'y	Mid'le States.	May.	Sep.
161	" Cristatus .	Common.	68	Migr'y	South. States.	May.	Sep.
162	" Minor....	Rare.		Migr'y	South. States.	May.	Sep.
163	" Rubicollis	Scarce.	68	Migr'y	South. States.	May.	Sep.
164	" Carolinensis	Scarce.	62	Migr'y	South. States.	May.	Sep.
165	Sterna Hirundo....	Common.	57	Migr'y	Tropics.	April	Nov.
166	" Arctica	Common.	75	Migr'y	M. & S. States	April	Nov.
167	" Nigra	Scarce.	60	Migr'y	M. & S. States	May.	Nov.
168	Larus Atricilla.....	Scarce.		Migr'y	Tropics.	April	Nov.
169	" Tridactylus..	Common.	74	Migr'y	United States.	April	Nov.
170	" Canus	Common.	71	Migr'y	Mid'le States.	May.	Sep.
171	" Fuscus......	Scarce.		Migr'y	Mid'le States.	May.	Sep.
172	" Argentatus ..	Scarce.	75	Migr'y	Mid'le States.	May.	Oct.
173	" Glaucus.....	Common.	75	Migr'y	Mid'le States.	April	Oct.
174	Anser Canadensis..	Common.	70	Migr'y	Mid'le States.	April	Nov.
175	" Hyperboreus .	Scarce.	73	Migr'y	United States.	April	Nov.
176	" Leucopsis ...	Rare.		Migr'y	....	April	Nov.
177	" Bernicla	Rare.	73	Migr'y	South. States.	April	Nov.
178	Cygnus Ferus......	Rare.		Migr'y	....	April	Nov.
179	Anas Boschas	Common.	68	Migr'y	California.	April	Nov.
180	" Clypeata	Scarce.	70	Migr'y	Mexico.	April	Nov.
181	" Strepera	Rare.	68	Migr'y	Mexico.	April	Oct.
182	" Obscura	Common.		Migr'y	Mid'le States.	April	Nov.
183	" Discors	Common.	58	Migr'y	Mexico.	April	Nov.
184	" Crecca	Common.	70	Migr'y	Tropics.	April	Nov.
185	" Americana....	Scarce.	68	Migr'y	M. & S. States	May.	Oct.
186	" Acuta	Common.	70	Migr'y	Mexico.	April	Oct.
187	" Sponsa	Common.	54	Migr'y	Mexico.	April	Oct.
188	" Albeola......	Common.	68	Migr'y	Mexico.	April	Nov.
189	" Clangula	Common.	68	Migr'y	M. & S. States	April	Nov.
190	" Histrionica ...	Rare.	68	Migr'y	Mid'le States.	May.	Oct.
191	" Perspicillata..	Rare.	72	Migr'y	United States.	May.	Dec.
192	" Fusca	Common.	72	Migr'y	Mid'le States.	April	Nov.
193	Harelda Glacialis ..	Common.	75	Migr'y	Mid'le States.	April	Nov.
194	Fuligula Ferina....	Scarce.	68	Migr'y	M. & S. States	May.	Oct.
195	" Marila	Scarce.	68	Migr'y	M. & S. States	May.	Oct.
196	" Rufitorquis...	Rare.	68	Migr'y	M. & S. States	May.	Oct.
197	Mergus Serrator ...	Common.	68	Migr'y	South. States.	May.	Oct.
198	" Cucullatus .	Scarce.	68	Migr'y	South. States.	April	Oct.
199	" Merganser..	Common.	68	Migr'y	United States	May.	Nov.

BIRDS.

Fam. Accipitres.—Genus Falco.

Gen. char. Beak more or less hooked, furnished with a cere which is more or less hairy, and usually coloured ; mandibles frequently dentated ; nostrils lateral, rounded or oval, open, and surrounded by the cere ; tarsus feathered or naked, in the latter event always scaly ; toes four—3 before, and 1 behind ; anterior middle one longest, and the exterior usually connected with it by a membrane as far as the first joint ; talons sharp, more or less curved and retractile ; tail of 12 feathers ; wings long.

Sub-gen. Falco.

Sub gen. char. Beak short, incurved ; upper mandible with one or two teeth ; legs robust ; tarsi short, toes long ; talons sharp and hooked ; 1st and 3rd primaries subequal, 2nd longest. The 1st and 2nd have an abrupt emargination of their inner web towards their extremities.

F. sparverius. Sparrow hawk.

Falco (*Tinnunculus*) *sparverius.* Linnæus and Baird!

V.S.P. Cere yellow ; legs and feet yellow ; bill bluish black : irides hazel ; eggs 4 to 5, brownish yellow, mottled brown. Male plumage, dorsal aspect.—A black streak from each angle of the mandibles ; crown of head reddish brown, surrounded by a coronet of ashy blue ; auriculars white, a narrow white line forms the base of the frontlet, and is continued over the eye ; the back and nearly the whole tail, light reddish brown ; interscapular region dotted with black. Ventral aspect.—Chin, throat, breast, belly, and vent dirty white, with oval black spots across the body, and continued thence to the wings as far as the primaries ; secondaries ash blue above, with black oval spots ; primaries black, with their inner webs barred with white ; inferiorly the inner webs of both are barred with faint black lines on a white ground, the outer webs being wholly black. The outer lateral tail feather barred with black and white, the bars continued to the outer web of the 2nd ; all the other tail feathers of the dorsal tint ; a broad black bar terminates the reddish brown, which is itself terminated, except in the two central feathers, by a white tip. The same distribution of colour marks the under surface of the tail, only fainter. Length from the bill to the extremity of the tail fourteen inches ; alar expanse twenty-six inches. The female presents the same characters about the head as the male. On the

occiput, however, the ash blue ceases, and the whole remaining dorsal region presents a uniform series of deep reddish brown, and brownish black bars; on the tail these bars are 10 or 12 in number. The ventral aspect is white with longitudinal brown streaks.

F. columbarius. Pigeon hawk.

Falco (*Hypotriorchis*) *columbarius.* Linn! Baird!

V.S.P. Bill light blueish gray, tipped with black; eyelids and cere greenish yellow; tarsi yellow; eggs 2 to 4 mottled with red.

Dorsal aspect. Feathers on the head and back of the neck, black with brown edges; a light brown streak from the cere proceeds backwards over the eyes, which are prominent, and is lost on the neck. From this part downwards the colour is deep chocolate brown. The primaries and secondaries have this colour relieved by whitish brown oval spots, tipped with the same. The tail with 4 interrupted whitish brown bars, with a terminal one of same colour.

Ventral aspect. Chin, throat, auriculars, breast, belly, and vent, with the femorals, yellowish, streaked chocolate brown. On the chin and throat these streaks are little more than confined to the shafts of the feathers, but on the breast and belly they are large, and of a lanceolate shape. The under tail coverts are streaked like the femorals; under surface of the tail chocolate brown, barred with white; the wing linings yellowish brown, spotted with white, and the inner surface of the primaries banded like the tail.

The bill is compressed, hooked, deeply toothed, with a corresponding groove in the lower mandible; nostrils round; 3rd primary longest; 2nd about a line shorter, and 1st about a line shorter than 4th; tail square, the feathers angled off at their tips; toes with cushions at the joint; middle toe longest, more than twice the length of the hind toe. Length of a specimen in the author's possession, 12½ inches; alar expanse 25 inches.

Sub. genus Aquila.

Sub. gen. char. Bill strong, of considerable length, hooked towards the apex and straight at the base; eyes sunk; nostrils subcircular; cere hispid; 4th and 5th primaries longest: legs strong, feathered to the toes; toes strong; talons incurved, and channelled inferiorly.

F. chrysaetos. Golden eagle.

F. fulvus of Temminck!

F. Canadensis of Gmelin!
Aquila fulva of Meyer!
Aquila Canadensis. Linn.! Baird!

V.S.P. Cere and feet yellow; irides orange brown; beak blue at the base, brown at tip; eggs 2 to 3 impure white, spotted red.

Dorsal aspect. Crown of head and nape of neck with acuminate feathers of a bright rufous orange tinge. The rest of this aspect dark brown, more or less inclined to black, according to the age of the bird.

Ventral aspect. Dark brown verging to black; tail dark grey, banded irregularly with blackish brown, and terminated by a broad band of the same colour; scapulars invariably brown. "The young is uniformly of a ferruginous brown, and with the feathers nearly all white towards the base; tail white, with a broad terminal brown and mottled band and no bars. (Nuttall.) Length about 3 feet; alar expanse 6 feet. Female about 6 inches longer than the male.

Sub genus Haliaetos.

Sub. gen. char. Ridge of the beak convex and compressed; nostrils luneiform; cere slightly hispid; wings long; tarsi feathered on their upper half with short close set feathers, and scutellated on the anterior inferior portion; talons of equal length, much bent and grooved internally.

F. leucocephalus. Bald or White headed eagle.
Haliaetos leucocephalus. Linn.! Baird!

V.S.P. ET V. Bill, cere, irides and tarsi, yellow. The young bird with a black bill and pale brown irides.

Ventral and dorsal aspects. Head, upper part of neck, tail and coverts, pure white; body and wings chocolate brown; the margins a shade or two lighter; quill feathers brownish black with paler shafts; 4th primary longest; 3rd subequal; outer webs of the primaries sinuate; inner webs abruptly emarginate towards their ends; tail round; tarsi feathered for more than half their length; the anterior naked part strongly scutellated; hind toe very long, and its talon longer and stouter than the others; middle toe longest, with the shortest talon and grooved on its inner surface. Length 38 inches; alar expanse 61 inches.

This bird does not assume its adult plumage until the 4th year, during which time its plumage varies considerably according to its age. Young bird. Feathers of the head and neck acuminate, inter-

nally white, then umber brown, and tipped with whitish brown. Whole dorsal aspect except the wings pure brown ; tail black with minute whitish brown mottlings on the outer vanes of the feathers and blotched with pure white on all the inner vanes except the two centre feathers. Ventral aspect. Feathers of the chin and throat like the head, the white however more apparent; breast, belly and vent, brown ; inner wing coverts white tipped with brown ; primaries white, 2nd mottled with whitish brown on both vanes; tertiaries white, mottled with brown and brown tips; tail round, blotched with white about the centre of each inner vane; femorals blackish brown, with whitish brown tips to the end of the shafts ; tarsi yellow, very strong, feathered on the upper half; toes stout, thickly cushioned ; claws long, much curved, deeply grooved and compressed along their inferior margin; claws of the inner and hind toes equal in length ; bill $2\frac{1}{8}$ inches long from the eye ; the curve commencing at the extremity of the cere which projects half the distance ; nostrils oval diagonal and naked ; upper mandible lobed near the end, beyond which the inner surface drops perpendicularly to form the apex; there is another rudimentary lobe a little posterior to the front one ; lower mandible not notched, but rather compressed at its sides ; the wings extend to about $2\frac{1}{2}$ inches of the extremity of the tail. Length 38 inches ; alar expanse 72 inches.

Another specimen, a younger bird probably, or perhaps of a different sex, presented throughout the same essential characters, but differed slightly in the colour, which was lighter and more rusty. It measured 40 inches with an alar expanse of 76 inches.

The young of this species has often been confounded with that of the *F. chrysaetos.* The distinguishing characteristic is, that in the latter the tarsi are completely feathered, while in the former they are only feathered on their upper half, the lower half being naked and scaly. The young of the *F. albicilla*, an European species, resembles our present bird more than any other. Temminck has suggested that the tail of the European species is larger than that of ours; Richardson suggests another characteristic, that the upper mandible of the former has two lobes, while that of the *F. leucocephalus* has but one. From what I have seen there seems to be a mistake here, for the two specimens alluded to, which have furnished me my description, have very evidently two—a large very obtuse one near the curve, and a 2nd one

not so large, but perfectly distinct behind it, and a little anteriorly to the base of the cere. It is the case also in another specimen which I have since examined.

F. haliaetos. Fish hawk or Osprey.
Aquila haliætus of Meyer!
Type of sub gen. Pandion of Cuvier!
Pandion Carolinensis. Gmelin! Baird!

V.S.P. Cere and bill bluish black; claws pale blue; irides orange and yellow; eggs 2 to 4 cream yellow, with red blotches; tarsi strong, about 2 inches long, feathered down their anterior surface, and scutellated on their other parts, the scales being rounded and tiled; soles and inner surface of the claws shagreened; talons curved, tapering, rounded beneath.

Crown of the head white on each side, with a central streak of black continued to the neck, these feathers occasionally edged with yellow, and erectile; a dark brown stripe includes the orbit and is lost upon the shoulders. Dorsal aspect generally umber brown verging to black; tail brown and barred with a deeper brown; the inner vanes of the feathers barred with dusky brown and brownish white; wing feathers with the outer vanes black, and their inner ones barred similarly to the tail. Ventral aspect generally white, with yellowish delineations on the breast; anterior and lateral femorals streaked with brown; inner and posterior ones white. The female is two inches longer than the male, and is spotted with brown on the breast. The young birds have the feathers on the dorsal aspect tipped with yellowish white, have a fawn coloured spot on the breast, and blue feet. Length of an old male 23 inches; alar expanse 54 inches.

Sub genus Astur.

Sub gen. char. Bill strong; tooth well defined; nostrils rounded; middle toe longest, and connected to the adjoining outer one; 4th primary longest.

F. palumbarius. Goshawk.
F. atricapillus of Wilson!
F. regalis of Temminck!
Type of sub genus Astur of Bechstein!
Type of sub genus Dædelion of Savigny!
F. gallinarius, Young, Gmelin and Frisch!
Astur atricapillus, (Wils.)! Bonap.! Baird!

V.S.P. Bill blackish blue, whitish below the cere, with a corresponding spot on the lower mandible; cere and legs yellow;

irides orange yellow; eggs 2 to 4 blue white, mottled with brown.

Dorsal aspect. Crown of the head, nape of the neck, cheeks and auriculars black, with the white bases of the feathers appearing. A white stripe, with the shafts of the feathers black, crosses over the eyes, from the base of the bill on each side, and loses itself upon the neck; back, wing coverts, interscapulary regions as far as the rump blueish gray with black shafts; primaries and secondaries with their coverts brown, with lighter edges; rump white, with two perfect brown bars, and occasionally an imperfect third: tail, two centre feathers blueish grey, with 4 dark brown bars, and an imperfect fifth; four next lighter brown, with five distinct bars, imperfectly continued to the inner vane of the last feather; primaries dark brown, mottled white towards their insertion.

Ventral aspect including the femorals and wing linings of short wavy lines of greyish black on a white ground, with dark grey shafts; tail dirty white with brown bars, indistinct on the two outer feathers; tail coverts white, a few of them mottled grey.

Tarsi half feathered; toes strong; talons curved, long, grooved inferiorly, the middle one with a salient inner edge; upper mandible compressed, toothed; lower one rounded near the apex; nostrils oval, clothed with stiff hairs presenting a stellated appearance a little over the commissure of the mouth. The upper hairs meet over the nostrils, all closely appressed; 4th primary longest; 3rd about a line shorter; 2nd, 3 lines shorter than the 3rd; 1st about half an inch longer than 6th, and shorter than the 5th. Length 26½ inches; alar expanse 42 inches. The female is met with about 5 inches longer than the male. Her dorsal aspect is brown, slightly tipped with white, and a white relieves the place of the mottled ventral aspect of the male with occasional patches of brown of an oblong shape on the breast and throat, and oval on the belly. In both male and female the tail is much rounded, the outer feathers being 1½ inches shorter than the centre ones.

F. fuscus. Slate coloured hawk.
F. Pennsylvanicus of Wilson! Adult male.
F. velox of Bonaparte! Young female.
Accipiter fringilloides of Vigors!
Accipiter Pennsylvanicus of Swainson!
Buteo Pennsylvanicus. Wilson! Bonap.! Baird!

V.S.P. Bill blueish black; cere geenish yellow; irides reddish orange; tarsi bright yellow; claws black; eggs 4, dirty white blotched with red.

Dorsal aspect. Crown and nape of the neck blackish, soon changing to a blueish grey, which invests the whole dorsal region, including the wings and tail; the shafts of the primaries, secondaries and tail feathers brown; the shafts of all the other feathers black. Towards the primaries and tail, the blueish grey changes to a brown, which in the former is barred with a deep brown mottled with white, and in the latter is intersected by 4 broad bars of a deep brown colour, and tipped with white. The 1st band is imperfect, the three next are very distinct, and gradually increase in breadth. The last one is very broad, and bounded by the terminal white tip.

Ventral aspect. Chin and throat white, with black shafts; breast, belly, and vent reddish brown, barred with white, and black shafts; femorals like the belly with white shafts; wing surfaces white barred with brown, the white changing to an ashy blue towards the extremities of the primaries and secondaries; tail coverts white; the bars on the under surfaces of the wings and tail very distinct.

Legs long; scales on the anterior surface of the tarsi minute; toes long; middle one longest, and twice the length of the hind toe; claws long, curved, sharp, and grooved beneath; nostrils oval, placed longitudinally; 1st primary equal to the secondaries; 2nd about two lines longer than 1st; 3rd and 6th subequal; 4th longest, and 5th about a line shorter; tail square. Length of a male in the author's possession $11\frac{1}{2}$ inches; alar expanse 21 inches. Nuttal says that "the feathers on the breast and sides of a young female were marked with broadish transverse pale brown bars, terminated by oblong, oblanceolate spots."

F. Cooperii. Cooper's Hawk.
Accipiter Cooperii. Bonap! Baird!

D.C. This bird I have not yet met with, but have no doubt, in consequence of its range, that it is an occasional visitant in this section of Canada.

"Tail rounded, with 4 blackish bands, and tipped with white, wings extending when folded to the second band. 2nd quill nearly equal in length to the 6th, and the 3rd to the 5th. Length 18 or more inches. Young, dusky brown, skirted with ferru-

gineous, beneath white, with oblanceolate dusky brown spots." (Nuttal).

Sub genus Buteo.

Sub gen. char. Bill short, curved from its base; lobe blunt; sides of the lower mandible in-curved; wings long; 1st primary shortest; four first primaries indented in their inner web. The tarsi of some are feathered the whole length, distinguished from the eagles by their bill curving from the base, and from the goshawks by the naked space between the eyes and bill.

F. lagopus. Booted hawk. Rough legged falcon.
F. Sclavonicus. Latham !
F. spadicius of Idem !
Archibuteo lagopus. Brünnich ! Gray ! Baird !

V.S.P. ET M. Cere and irides light drab; tarsi yellow; bill and claws black; eggs 4, white, mottled with red.

Dorsal aspect. Head and neck light yellowish brown, streaked with umber brown, and black shafts; dorsal region as far as the rump umber brown, the feathers edged with light yellowish brown, these tips disappearing towards the rump; wing coverts umber brown, tipped with rufous; four first primaries indented in their inner webs, white near their quills, and dark chocolate brown towards their extremities; shafts white, edged with brown along the quills, the remainder brown; the basal half of the tail is brownish white, terminated by umber brown, tipped with greyish white.

Ventral aspect. Throat, breast and belly, like the upper surface, but with narrower streaks; on the breast the streaks are broader; then comes an apparent interruption, which is followed by a broad belt of umber brown across the belly; the feathers here being, except in the centre, not edged with white; wing coverts and vent feathers brownish white, with white shafts; tail yellowish white at the base, with a terminal slate grey border; inner shafts of all the wing feathers white, the quills themselves white towards their base, with their distal halves shining blackish brown; shoulders white; tarsi feathered to the toes; femorals very long reaching to the toes, yellowish brown, streaked with chocolate, in the form of an oval spot at the extremity of each feather.

Toes stout, cushioned; middle toe longest; claws long, strong, not much curved, grooved beneath, the middle one with a salient

inner edge. Length 24 inches; alar expanse 50 inches; 1st and 7th primaries equal; 2nd about 1½ inch longer than 6th; 3rd and 5th equal; 4th longest; 2nd two lines longer than the 3rd; tail square. "The female is generally lighter on the back, but browner on the sides and belly. The young bird has the belt only indicated by large brown spots on the side, with the feathers of the thighs transversely barred. The tail with three broad bands towards its extremity, and with the iris brownish yellow." (Nuttall).

F. Sancti Johannis. Black hawk.

F. niger. Wilson!

Archibuteo Sancti Johannis. Gmelin! Gray! Baird!

V.S.P. The only specimen of this species which has fallen under my notice is a young bird shot this spring (1838) at the Priests' Farm, Montreal, of which the following is a description. I have little doubt but that this species and the former have frequently been confounded by naturalists.

"Bill black; cere, angles of the mouth, and tarsi yellow; eggs unknown; irides yellow; whole dorsal and ventral aspects uniform blackish brown, with the white under surface of the feathers appearing on crown and throat; primaries, secondaries, and the tail white, with their distal halves clove brown; 3rd, 4th and 5th primaries indented on their outer vanes; tail with brownish white tips to the feathers and not barred, and with brownish white shafts; femorals long reaching nearly to the toes, with light brown emarginations to the feathers; tarsal feathers brown tipped like the femorals; 3rd primary longest; 2nd shorter than 4th; 1st and 7th equal; hind claw longest; anterior middle claw with an inner salient edge. Length 23 inches; alar expanse 43 inches. The bill, legs and claws more slender than in the *F. lagopus.* Audubon considers the variety as the result of age. He told me so in 1842, when in this city.

F. Dawsonis. Dawson's Falcon. (New Species, Hall!)

I have only seen two specimens of this beautiful Falcon, the one in the Museum of the Natural History Society, and evidently from its dimensions, as well as fact, a female; the other a young male belonging to Mr. Hunter, the taxidermist of the Society. The first was bought in the market of Montreal a few years ago, and the second was shot at Lachine this autumn (1861) by a relation of Mr. Hunter. It bears some resemblance to Prof. Cassin's Hiero-

falco sacer, especially his description of the young bird, but differs from it in having the claws black; and the under part of the claws are not greenish yellow, but of the same hue as the tarsus; and the general tint of the dark parts of the plumage is not brown, but emphatically slate color. It also somewhat resembles the description given by the same gentleman of the F. atricapillus or plumbarius but differs in having greenish blue tarsi, and a bluish cere. with black irides. I believe this bird to be a new species, and have taken the liberty of calling it after Dr. Dawson the esteemed principal of McGill College.

V.S.P. Bill stout, strongly toothed in upper mandible, the tooth corresponding with a notch in the lower one, of a bluish color, terminating in a black tip, which is the color of the cere and irides. Tarsi feathered half way to toes, of a dark greenish blue. Toes long, moderately strong, claws black and much curved. Eyelids dirty white this color forming a complete circle round the eyes.

Dorsal aspect. The prevailing tint is dark slate color tipped with cinereous on the back of the neck, interscapulars and secondaries, and with rufous on the back, the upper tail coverts tipped with dirty rufous white. Many of the secondaries have a rufous white rounded spot near the end of their outer vanes. Tint of the upper part of the tail of a brownish slate color, with about 11 to 14 bars of light rufous terminating in rufous white near the tip, the tail tipped with the same color. The tail consists of about 11 feathers, the extremities of which are all rounded.

Ventral aspect. Chin and upper part of throat whitish, each feather having a narrow streak along its shaft of slate color. The prevailing tint, like that of the back is slate color, but differing from the back in that each feather has the outer vane white, with an irregular long white spot on the inner vane, leaving the central portion of the prevailing color. Femorals as long as the tarsals, the white on the feathers here assuming almost a banded or barred appearance, which in the female is distinctly so. Under tail coverts of alternate rufous white and slate colored bars. The under surface of the tail exhibits a rufous tint, while the bars are more distinctly seen.

2nd. Primary longest; 1st shorter than the 3rd, but longer than the 4th; inner vanes of the primaries barred with white.

The female which resembles the male in every respect except the bars on the femorals, had its bill a good deal worn, thus indicating it to be an old bird. Length of the male 23½ inches. Alar expanse 38 inches. That of the female 27½ inchest with an alar expanse of of 42 inches.

F. buteoides. Short winged buzzard.

F. buteo of Pennant!

V.S.P. ET V. Bill and claws black; tarsi yellow; irides (" dark brown," Nuttall,) bright yellow; eggs 2 to 4 whitish, waved with green and spotted yellowish.

Dorsal aspect. Feathers of the head, neck, and dorsal regions blackish brown edged with ferruginous, least so on the back and head, and broadly so on the neck; scapulars brown, with indications of white bars on the inner vanes below the surface; a ferruginous tint predominating on the outer vanes, and a white on the inner vanes; wing coverts ferruginous brown, tipped with ferruginous white, and indications of white bars on the inner vanes of the greater coverts; rump brown; tail coverts, centre ones white on the outer vanes, barred with white on the inner vanes, on a blackish brown ground, and tipped with white: tail round, ferruginous near the base, soon changing to a pale brown, tipped with soiled white, and with 9 to 11 bars of dark blackish brown. Primaries clove brown; the quill halves of inner vanes ferruginous white, spotted with clove brown spots; the ferruginous white continued to the outer vane of the 2nd, 3rd, 4th and 5th; secondaries paler brown, with half of the inner vanes white barred with the brown.

Ventral aspect. Chin, throat, breast, belly, tail and wing coverts white, tinged with ferruginous, with oval and oblanceolate brown spots at the end of each feather; vent ferruginous white; femorals the same colour with a lanceolate spot of brown.

Legs long, feathered for one-third their length, scutellated on the remaining portion. 4th primary longest; 3rd a little shorter than 5th; 2nd about 4 lines longer than 6th; 1st and 8th equal.

F. borealis. Red tailed hawk.

F. levorianus young bird.

Buteo (*Poecilopternis*) *borealis.* Gmelin! Vieill.! Baird!

D.C. " Bill greyish black; cere, sides of the mouth, and tarsi yellow; upper parts dark brown touched with ferruginous; scapulars barred beneath the surface; the lateral tail coverts white, barred with rusty; middle ones dark; tail rounded, extending two inches beyond the wings, of a reddish brown or brick colour, with a single band of black near the end, and tipped with brownish white; the breast rust coloured, streaked with dark brown; chin white; vent and femorals pale ochreous, the latter with a few small heart shaped spots of brown; iris yellow. Length 22

inches; alar expanse 45 inches." (Nuttall). I have not met with a male bird as above described, but the following description is from a young female in a state of moult, probably her first. It differs somewhat from a description of an old female by Richardson.

v.s.p. Bill and claws blueish; cere and legs greenish yellow; feathers on head and back with streaks of chocolate brown, narrow on the head, and streaked with white, except on the shoulders, where a rufous tinge terminates them. Vanes of the primaries yellowish brown towards the base, with indication of bars, changing to brown on their distal halves; upper tail coverts barred with brown; the last bar on each feather heart shaped. Tail dark chocolate brown, tipped with dirty white, and having 8 bars of a reddish brown, the red line gradually disappearing towards the extremity where it changes to a light brown. Basal ends of the primaries and secondaries, white or yellowish white, soon changing to slate colour with bars. Femorals, yellowish white, with minute brown spots near the extremity of the shafts. Tarsi feathered anteriorly for an inch, and thence protected by 12 tiled scales; length, 22 inches; alar expanse, 44 inches.

F. hyemalis, Winter falcon or red shouldered hawk.

F. hyemalis, adult male of Audubon and Wilson.

F. lineatus, young male of Audubon.

Buteo (*Poecilopternis*) *lineatus*. Gmelin? Jardine!

v.s.p. Bill blackish, cere and legs yellow; irides reddish hazel.

Dorsal aspect. Feathers on the head and neck acuminate brown, edged with ferruginous and black shafts; on the back and rump dark brown, edged with lighter brown; small wing coverts reddish brown, with a black stripe down their centres. Greater wing coverts brown, with reddish brown tips; primaries and secondaries, dark brown, barred and tipped with white; scapulars of a lighter hue, barred also. Tail, umber brown, with 6 white bars, and tipped with white.

Ventral aspect. Chin and throat like the head; prevailing hue of breast and belly, femorals and wing linings, bright rufous barred with white and shining brown shafts; vent and tail coverts cream white; wing and tail surfaces brownish white, barred with slate colour.

1st primary about two lines longer than the secondaries; 2nd, two lines longer than the 6th; 3rd and 5th, equal; 4th, longest;

wings about one inch shorter than the tail. This elegant bird measures 22 inches, and has an alar expanse of 44 inches. The above description is from a very perfect specimen in the author's possession. Young " brown and ferruginous, beneath rusty slightly varied with faint bars; wings dusky and barred; tail black, crossed and tipped with 5 bands of white." (Nuttal.)

Buteo insignatus. (Cassin! Baird!) McCulloch's or the Canada Buzzard.

D.C. Form robust; wings rather long, 3rd quill longer, secondaries emarginate at their tips; quills unusually broad; tail rather short, slightly rounded; tarsi feathered in front below joint; naked behind, having in front 10 transverse scales; under wing and tail coverts white, the former striped longitudinally with pale ferruginous, and some of the transversal with dark brown; the latter with transverse slips of pale reddish brown.

Plumage of the tibia dark ferruginous mixed with brown; throat and a few feathers in front white, with narrow lines of black; entire other plumage above and below, dark brown, nearly every feather having a darker or nearly black line on its shaft; quills above brown with a purple lustre, beneath pale ashy with their shafts white, and irregularly barred with white near their bases; tail above dark brown, with an ashy or hazy tinge, and having about 10 obscure bands of a darker shade of the same colour beneath nearly white, with conspicuous bands of brown, the widest of which is next the tip which is paler; tarsi and feet yellow.—Sex unknown. Dimensions. Total length, (of skin) 17 inches; wing $14\frac{3}{4}$, making an alar expanse of $29\frac{1}{2}$ inches; length of tail, $7\frac{1}{2}$.

Hab. Canada, Dr. McCulloch and Dr. Hall.—Specimen in the private collection of the late Dr. McCulloch, now possessed by Mrs. McCulloch.

Frequently after having examined this bird, the late Dr. McCulloch and myself considered it new, but we had no means of verifying our opinion, until the visit of Prof. Cassin, of Philadelphia, in 1854. Dr. McCulloch fell a victim to the cholera during its epidemic of that year, and the following spring it was forwarded to Mr. Cassin, in Philadelphia who identified it as a new species. Only one specimen has as yet been obtained in this country, although Mr. Cassin has had the good fortune to secure a second specimen, which now constitutes the representative of this Buteo in the museum of the Academy of Natural Sciences, Philadelphia.

In colour it resembles, in some respects, the young of the Circus Hudsonius or ferrugineus. The specimen above described was shot in the vicinity, I believe, of Terrebonne, and was brought to the late Dr. McCulloch, by one of the farmers residing in that neighborhood. It is evidently a very rare species, as this is the only specimen of it which has been seen here. The foregoing description I have taken from Prof. Cassin, who has described the bird under its present name, "Buteo insignatus", in his valuable work, "Illustrations of the birds of California, Texas, Oregon, British and Russian America." In memory of the late Dr. McCulloch, and his promotion of the study of the natural sciences in this city, it should receive the name of McCulloch's Buzzard, although Mr. Cassin has attached to it the name of "Canada Buzzard."

F. Cyaneus, Hen harrier.

F. uliginosus. Wilson and Buonaparte!!

D.C. I have never met with a specimen of this bird, but from its extensive geographical range, it ought to be an occasional visitant with us. The following description is from Nuttal's "Ornithology of the United States and Canada."

"In the old male, the upper parts are of a blueish gray. The quill feathers are white at their origin, and black the rest of their length; the internal part of the base of the wings, rump, belly, sides, thighs, abdomen and beneath the tail is white without spots; upper part of the tail of a cinereous gray, with the ends of the feathers whitish; iris and feet yellow; length 20 and 21 inches."

We desire only to add to our list of the Falconidæ, which we have endeavoured, with every care, to render as perfect and complete as possible, that with the varying names given to the species by authors, together with the differences in plumage, (sometimes remarkable) between the male and female bird, and also between that of the young bird and its parents, the greatest of difficulties has originated and has unquestionably caused, in our opinion, some mistakes in the nomenclature. With the exception of the Gull and Tern tribes, to which we might add one or two other genera, we know of none more difficult of study, or identification than the Hawks.

GENUS STRIX.

Gen. char. Bill compressed and curved from the base. Cere more or less covered by stiff, erect hairs; head large, feathered; nostrils lateral, rounded, open, and concealed by the

hair of the cere; eyes large, orbits surrounded by feathers which are erect, or in a stellated form around them, giving the appearance of a flattened disk; tarsi feathered, often as far as the talons; feet 4-dactyle, three before and one behind; outer toe versatile; 3rd primary longest.

Sub-gen. Surnia.

Sub-gen. char. External auditory apertures oval—of moderate size—naked—facial disk small and composed of slender feathers which are repressed along the cheeks. This genus forms a connecting link between the hawks and true owls.

1st. Subdivision.

Heads without ears or tufts.

S. funerea. Hawk owl.
S. Hudsonia of Wilson.
Surnia ulula. Lemm.! Bonap.! Baird!

v.s.p. Ridge of the upper mandible yellow; its inferior portion, with the lower mandible black; claws black; irides bright yellow; eggs two, white.

Dorsal aspect. Hair-like feathers of the cere gray, with black mucronate shafts; facial disk composed of grayish white stiff feathers, bounded by black posteriorly; upper surface of head and neck deep blackish brown, with numerous white spots. Dorsal region; scapulars, wing coverts and rump, brown, with less numerous white spots, except on the scapulars which appear almost barred with white; tail rounded, brown, with seven imperfect white bars.

Ventral aspect. Chin grayish black; the black line bounding the facial disk, continued to the fore part of the neck; behind this a white streak, the feathers composing which are tipped with black; this again is bounded by another black line; the two black lines meeting behind the ear, and thence diverging to the neck; breast, belly, and vent grayish white, intersected by numerous narrow rusty brown bars; under the wings, these bars assume a darker tint, which is continued to the inner wing coverts; femorals and tarsals silky. of a dirty yellow colour and faintly barred, the feathers continued to the extremities of the toes; tail itself brownish slate colour with distinct white bars; primaries and secondaries barred internally; the bars composed of white spots on the vanes of all the feathers; the outer vane of the 1st. primary has its barbs slightly recurved.

3rd. primary longest; length 16 inches; alar expanse 28 inches. The female has the tints less clear, and the young bird has the plumage of a rusty brown.

S. nyctea. Snowy owl.
S. candida of Latham!
Nyctea nivea. Gray! Baird!

V.S.P. ET V. Bill and claws blueish black; irides bright yellow; eggs 2 white.

Dorsal aspect. Facial disk white; head, neck and whole dorsal region pure white, with more or less distinct umber brown, in some instances, blackish bars; rump and tail coverts white; tail white with three imperfect terminal blackish bars; primaries and secondaries white, with bars on the vanes of the former, and black spots on the inner webs of the latter.

Ventral aspect. Throat, vent, tail coverts, wing linings, and tail white; breast and belly white barred like the back.

Nostrils large, oval, obliquely situated at the margin of the cere; femorals as long as the tarsus; tarsus feathered to the talons, the feathers here being long and soiled; claws black, long, curved, and very sharp; 3rd primary longest; 2nd, 3rd and 4th have their outer vanes abruptly notched; barbs of the outer vane of the 1st primary have their points reverted and open. Length 25 inches; alar expanse 54 inches. The female is a little larger than the male, and more spotted. The old males are nearly altogether pure white.

2ND SUBDIVISION.

Heads furnished with ears.

S. nævia. Mottled owl, or screech owl.
S. asio, male. Audubon!
S. asio of Linnœus!
S. nævia of Wilson! Adult.
Scops asio. Bonaparte! Baird!

V.S.P. Bill and claws white bone colour, the latter tipped with black; irides bright yellow; at a distance the prevailing hue of the bird is gray.

Dorsal aspect. A near approach defines the facial disk to be of a gray white colour, with a pale brown line on the upper eyelid; the disk bounded by a black line meeting in the throat, and terminating below the ears; hair-like feathers of the cere, very long; anterior ones projecting considerably beyond the bill; upper part of the head and neck gray and brown, streaked with

blackish brown—the streaks fading on the lower part of the neck; dorsal region, rump, scapulars, (except the outer vanes of the outer feathers which are white tipped with black,) and greater wing coverts, coloured like the head; inner vanes of the primaries and secondaries, light brown, with umber brown bars; outer vanes of the primaries ferruginous next the shaft, with white edges, and barred like the inner vanes; outer vanes of the secondaries, mottled and barred with brown, gray, and white; tail dark brown, with 7 or 8 bars of a reddish brown; the bars being indistinct on the distal end, which is also mottled with brown.

Ventral aspect. Above and below the black streak on the throat, white prevails; breast and belly, gray white, with light brown bars, and blackish brown streaks; these streaks are very large on the breast, and become narrower towards the vent; vent feathers white; tail coverts generally white, with indications of brown bars; the lateral feathers white and very silky; wing coverts present the same characters; quills slate colour, with gray bars; femorals and tarsals silky, 4 or 5 inches long, and slightly tipped with rufous superiorly; toes feathered only to the last joint; ears composed of 8 to 10 feathers coloured like those on the head.

4th primary about a line longer than 3rd; 3rd equal to 5th and 2d to 6th; 1st primary not longer than the secondaries. "Outer and inner vanes of the 2nd, 3rd, and 4th primaries notched." 5th notched on the outer vane. The barbs of the outer vanes of 1st and 2d primaries revolute. Claws long, much curved; inner edge of the middle toe, salient, and very sharp, outer toe versatile. Hind toe very short, shorter than the outer one. Middle toe longest. Length 13 inches; alar breadth 20 inches. I must observe that the colours of this bird are much blended with one another, and render the description of it no easy task. The female has a prevailing reddish brown tint, streaked and barred with ash and brown; face whitish; breast and belly whitish, with bars and streaks of black and brown; femorals and tarsals pale brown; irides yellow, bill and claws greyish horn color. She lays 4 to 6 eggs, which are white and nearly round. The young bird is tawny red, with narrow dark spots along the shafts of the feather.

Sub-genus Bubo.

Sub-gen. char. Beak strongly inclined from its base, nostrils large, concealed; ears of moderate size. Facial disk tolerably distinct.

1st. Subdivision.

Heads with ears.

S. Virginianus. Great Horned Owl,

Bubo Virginianus. Gmelin! Bonap! Baird!

v.s.p. & v. Upper mandible black; lower one horn colour; claws pale at their insertion, changing to black towards their tips, irides bright yellow. Eggs 2 to 4, white, large.

Dorsal aspect:—Facial disk immediately round and in front of the orbits greyish black, bordered with reddish brown—the shafts of the feathers being continued beyond the vanes, and forming a kind of fringe. This fringe is bounded by a black border. Above the eye the facial circle is incomplete. Ear-tufts of 10 to 12 feathers, black on the outer vanes, and mottled brown on the inner vanes, the smaller posterior ones being wholly brown. Crown, neck, back, rump, scapulars, and wing coverts black, mottled with grey and brown, the light brown bases of the feathers appearing often through the black tips: the grey white on the back having an undulatory appearance. Primaries and secondaries mottled and barred, the inner vanes presenting on their quill halves a fine reddish brown colour, barred with dark brown. These vanes have a peculiar velvety feel, caused by a fine fringe projecting from the superior outer margin of each barb. The reddish brown almost changes to an orange on the secondaries. Tail banded with six blackish brown bars; the bars most distinct on the inner vanes, which are reddish brown, while the outer vanes, besides the bars, are much mottled with grey and brown.

Ventral aspect. Chin white, succeeded by a belt, which is continuous with the black border of the facial disk. This belt is succeeded by a crescentic spot of pure white, situated at the lower part of the throat. A little below the crescent, and separated from it by an irregular line of black and brown, commences a mesial line of pure white, broad at its commencement, gradually contracting and terminating at the vent. On either side of this line the feathers are white, barred with numerous fine zigzag delineations of umber brown, with lighter edgings, the yellow bases of the feathers appearing through them; flank feathers about 6½ inches long, enveloping the thighs and forming a kind of fringe underneath the tail; they are much barred; inner wing coverts white, barred with umber brown; tail light reddish brown, distinctly barred; femorals yellowish brown; tarsal feathers

whitish, barred with brown: of toes whitish and short with faint delineations of darker brown bars; toes feathered as far as the last joint, the feathers projecting over it.

3rd primary longest; 4th a little shorter; barb of outer vane of 1st primary revolute; length, $26\frac{1}{2}$ inches; alar expanse $46\frac{1}{2}$ inches.

2ND SUBDIVISION.

Heads without ears.

S. cinerea. Great Grey or Cinereous owl.

S. Lapponica of Temmink.

Syrnium cinereum. Gmelin! Audubon! Baird.

V.S.P. Bill pale horn colour, thickly embedded in the cere feather; claws black; irides yellow. Eggs 2, mottled with blackish brown.

Dorsal aspect. Facial disk large and well developed, black for a short space, immediately anterior to the orbits; all the rest grey, barred with a blackish brown; the bars concentric, 6 to 7 in number; disk bounded posteriorly by a circle of feathers, the front ones of which are velvety and of a deep liver brown colour; posterior ones white, with a deep brown streak along the shaft. Dorsal region, except the quill feathers of the wing and tail, blackish brown, mottled and barred with white, more or less pure. Quill feathers of the wing and tail blackish brown, barred with a lighter brown and mottled with dirty white, 5 to 6 bars; on the tail there is the same number of bars, but not well defined, composed of alternate deep clove brown and white streaks, with mottled whitish brown interstices. These motlings are most distinct on the two centre feathers.

Ventral aspect. Liver brown and white distributed in about equal proportions, without regularity; flank feathers brown, barred with white; wing and tail coverts dirty white, barred with brown; tail and wings brownish slate colour, mottled and streaked like the upper surface; tarsal feathers long, impure white, barred with brown; toes feathered as far as the origin of the claws; claws long, not much curved, sharp and compressed beneath with indications of a groove.

In the specimen before me the 6th primary is longest; 4th and 5th equal; 3rd about 2 lines shorter; 2nd about an inch shorter than 3rd, and the 1st equal to the secondaries, in consequence of which the wing when expanded has a rounded appearance; tail

rounded. Length 30 inches, alar expanse 56 inches. I believe it to be a female. The distinctive character between the sexes is rifling.

Sub-genus Ulula.

Sub-gen. char. Concha large, with a membranous operculum; facial disk well developed.

1st Subdivision.

Head with ears.

S. otus. Long eared owl.

Otus Willsonianus. Lessen! Baird.

v.s.p. Bill and claws black; irides orange yellow; eggs 4 to 5, white and subrotund.

Dorsal aspect. Facial disk black, immediately in front of, above and below the orbits; the black margin succeeded by grey; posterior parts ferruginous brown, inferiorly and posteriorly margined with white, the feathers tipped with black; auricular ring composed of velvety white feathers, mottled and tipped with liver brown, the line thus formed meeting on the anterior part of the throat, where the white predominates; dorsal region deep brown, mottled and barred with white; outer vanes of the scapulars and greater wing coverts, with white spots and a single bar of brown; the quill half of the primaries, yellowish brown, with brown bars; distal ends deep brown, with whitish bars, mottled with brown; tail like the primaries; the yellowish brown less distinct, and traversed by 11 bars of the dorsal colour, with intermediate bars of a fainter tint bordered with dirty white; tail tipped with white.

Ventral aspect. White with clove brown streaks, mottles and bars; wing and tail coverts yellowish white; quill half of primaries and secondaries, yellowish white; distal half, slate brown, with broad white bars; tail, yellowish white, verging to slate at its distal end and barred with deep slate brown; femorals and tarsals, yellowish brown; toes feathered to the last joint.

2nd primary longest; 3rd next; 1st next; 4th next. Ears long, composed of 8 to 10 feathers, black on the outer vanes, white mottled with brown on the inner vanes; barb of outer vanes of 1st primary revolute, of 3rd and 4th a good deal inflexed. Length 16½ inches; alar expanse, 34 inches.

S. brachyotos. Short eared owl.

S. brachyota of Latham!

Brachyotus Cassinii. Brewer! Baird!

D.C. This is one of our most common owls, but unfortunately at the time of writing, I cannot lay my hands on a specimen. The following is from Nuttall: "Ear-like tufts inconspicuous, of 2 or 3 very short feathers; general colour, ochreous, spotted with blackish brown; face round the eyes blackish; tail without 5 bands, not extending beyond the tips of the wings; female with the general tints paler. In the young the face is blackish. Length 13 to 15 inches. Head of old bird small; tail ochreous, with small bands, and tipped with white; beneath Isabella yellow, with longitudinal spots of blackish brown; bill black; feet and toes feathered: iris of a bright yellow."

2ND SUBDIVISION.

Heads without ears.
S. nebulosa. Barred owl.
Syrnium nebulosum. Gray! Baird.

V.S.P. ET V. Upper mandible yellow; lower one blueish black, except where it closes against the upper one; claws blueish black. Eggs 4 to 5, white; irides deep blue, verging to black.

Dorsal aspect. Facial disk in front of the orbits black, bounded by greyish white; all the other parts brownish grey, posteriorly barred and tipped with brown. A line of brown feathers, tipped and barred with white, bounds the facial disk and meets on the throat. Head, neck, back, rump, tail, scapulars, coverts, primaries and secondaries, liver brown, barred with white, which has a yellow tinge. These bars are most numerous on the neck, and most distinct on the back; those of the wings and tail have a brownish tinge, about 5 in number on the latter, and tipped with the same colour, and 5 or 6 on the wings composed of spots which are darker on the outer vanes.

Vental aspect. Chin brown; neck below the brown line continued from the facial disk, white, succeeded by white barred with liver brown. A single bar occurs on each feather, which is also tipped with the same. The bars change to streaks on the breast and belly; vent and tail coverts and wing coverts yellowish white, the second and last with narrow, brown specks; tail slate colour, with 5 bars; wings same, barred; femorals and tarsals short, yellowish white, with a faint barring; toes feathered to the last joint.

Claws long, not much curved but very sharp; claw of the middle toe longest, with a salient sharp inner ridge; hind toe compressed; 4th and 5th primaries equal, if anything 5th longest;

3rd and 6th equal; 2nd and 7th equal; 1st shorter than the secondaries; barbs of the outer vanes of 1st and 2nd primaries revolute; barbs of the outer vanes of 3rd, 4th, 5th, and 6th revolute at their tips; inner vanes of 2nd and 3rd, and outer vanes of 2nd, 3rd, 4th, 5th and 6th notched; tail rounded. Length 24 inches; alar expanse 42 inches. The female and young scarcely differ from the male.

In Richardson's description of the comparative lengths of the primaries of this bird, there appears to me to be an error. I have verified mine in several specimens, and find it differing substantially from his. And so far from the toes being "only half covered with feathers," in all the specimens that I have seen, they are distinctly covered to the last joint, the feathers thence protruding over the talons, and but 4 transverse scales appearing beyond this line, instead of 7 as mentioned by our author. I am inclined to the belief, that the remarks made by him at the end of his description of this bird in his Fauna, must have been derived from an imperfect specimen.

S. Tengmalmi. Tengmalm's owl.

S. Passerina? Wilson!

V.S.P. Upper and lower mandibles black, with the ridge of the former white; claws black; irides yellow; eggs 2, white.

Dorsal aspect. Facial disk, black in front of and below the orbits; below and posteriorly white, bordered by blackish grey, bounded by a line of deep velvety brown, mottled with white, and meeting on the anterior part of the throat, where the white predominates, and thence continued upwards to the chin, separated by a mæsial line of brown, and downwards for a little distance to the breast; crown and occiput liver brown, with white spots—these latter most numerous on the crown, and larger and more distinct on the occiput and nape of neck. The dorsal region liver brown, variegated with white spots, which are largest on the scapulars, on some of which a pair may be seen, but most generally, a single one is met with on the outer vane, of a round shape. Primaries marked by 5 rounded white spots on their outer vanes, and 5 correspondent linear bars on the inner ones; bars broadest on the secondaries; tail with 5 imperfect white bars, made up of oval spots on their outer, and of lines on their inner vanes.

Ventral aspect. Below the throat the prevailing tint is liver brown, mixed with nearly an equal quantity of white—the former colour predominating on the sides, and the latter on the middle

parts; wing linings and tail coverts dead white, with imperfect brown marks; wings and tail slate colour, with white spots corresponding to those on the upper surface; femorals and tarsals yellow white, with dark brown bars, the tarsals continued to toes as far as the insertion of the talons.

3rd primary longest; 2nd, 4th and 5th subequal; 1st and 7th equal; outer barb of the 1st primary revolute; tail square. Length 12 inches; alar breadth 20 inches.

Richardson refers the *S. Passerina* to the *S. Tengmalmi*, on no other grounds than a similarity in the plumage of the head. The two birds, however, are totally distinct; the *S. Passerina* not only being much smaller than the *S. Tengmalmi*, but differs also from it in its ventral plumage, which is wholly brown, and moreover, has but three white bars on the tail, whereas the *S. Tengmalmi* has five. A greater difficulty, however, occurs in the distinctive characters between the *S. Dalhousii*, *S. Passerina*, and *S. Acadica*, which resemble one another in nearly all their essential points. Might not the trifling varieties which are found to exist between them be the result of age? Nuttal refers the *S. Passerina* to the *S. Acadica*, to which I feel also much inclined to refer the *S. Dalhousii*. A degree of uncertainty, however, at the best, hangs over these species, which it would require a comparative examination of numerous specimens of different ages and sexes to clear up. The two following species agree with the plates of the respective birds, as figured in Wilson and Buonaparte's splendid work. The descriptions of both of them are taken from prepared specimens, shot in the vicinity of Montreal in 1837.

S. Acadica. Acadian owl.
S. passerina? Wilson!
S. Dalhousii? Audubon!
S. Acadica of Bonaparte;
Nyctale Acadica, Gmelin! Bonap.! Baird!

V.S.P. Bill and claws black; the former tipped with white at the apex of the upper mandible; irides pale yellow.

Dorsal aspect. Facial disk, white superiorly, and black anteriorly and posteriorly, with a few white feathers inferiorly; bounded posteriorly by brown feathers, tipped with white, forming a line which meets immediately below the chin; frontlet yellowish white; crown and nape of neck liver brown, (which is the prevailing dorsal tint) with indications of, or imperfect, white streaks

especially on the nape of neck. A white spot tinged with yellow on the outer vanes of the scapulars and wing coverts; 3 or 4 white spots on the outer vanes of the primaries, which are rudimentary on the 1st, and form bars on the inner vanes; tail with two white bands, tipped with white; the bars made up like those on the wings.

Ventral aspect. Breast and throat liver brown, distinctly defined; lower part of the breast and belly, reddish brown; tail and wing coverts whitish; quills of both slate coloured, barred with white; femorals and tarsals yellowish white, short, and continued almost like hair along the toes, as far as the talons.

Toes long and slender; middle toe, with the claw, 8 lines long; claws long, slender, very slightly grooved, except on middle toe, which has a salient sharp inner edge. Inferior surface of the talons compressed; wings much rounded when extended; 3rd and 4th primaries equal; 2nd and 5th equal; 1st and 8th equal; tail square. Length 8½ inches; alar expanse 16 inches. (Probably a female.)

S. Dalhousii. Dalhousie's owl.

V.S.P. The whole appearance very much resembling the former species.

Dorsal aspect. Facial disk dirty white round the orbit, except anteriorly, where it is blackish; extremities of the facial disk brown; auricular ring like that of the former; crown and nape of neck liver brown, streaked with white, the white streak being along the centre of each feather; scapulars, wing coverts, wings and tail, like the *S. Acadica;* the spots on the inner vanes of the primaries, however differing from those on the *S. Acadica*, in being oval, and scarcely presenting the appearance of bars.

Ventral aspect. Breast and belly streaked with reddish brown and white, instead of being wholly brown as in the former.

3rd primary longest; 2nd and 4th equal; 1st and 8th equal; resmbles the former in all its other characters.

S. Kirtlandii. Kirtland's Owl.

Nyctale Kirtlandica. Hog! Cassin!

This rare, beautiful, and diminutive of the owl tribe was caught alive in a grain store in this city a few years ago by Mr; Hunter, Taxidermist to the Natural History Society. It was identified through the instrumentality of Prof. Cassin's work on "The birds of California, Texas, Oregon, and British and Russian America." It is there mentioned as an inhabitant of the State of Wisconsin, by Dr. Hog, who first described it, having obtained his specimens

four in number, in the neighbourhood of Racine in that State. I am happy to have had it in my power to add it to the list of Owls.

V.S.P. Bill black and nearly concealed by small feathers and black bristles arising from its base. Irides yellow. Above eyes and on each side of bill a dirty white line; remainder of the front composed of chocolate brown feathers edged with dirty white, their tips causing at the edge of the front a dirty white line. Feathers behind eyes darkest. Tarsi feathered to extremities of toes with fine appressed ochrey colored feathers. Toes and claws long.

Dorsal aspect. Prevailing tint chocolate brown, relieved on the scapulars, secondaries and primaries by whitish spots, on the latter the spots existing on both the outer and inner veins, forming 3 or 4 imperfect bars. Tail with three bars of white and faintly tipped with the same color.

Ventral aspect. Chin and throat chocolate brown changing on the abdomen, flanks, and inferior tail coverts, to an ochry color. Under wing coverts whitish.

3rd primary longest, 2 and 4 subequal, 1 and 7 being about equal. Wings rounded when expanded. Length from crown of head to tip of tail 7½ inches. Alar expance 15 inches. The whole plumage is peculiarly velvety to the feel.

(To be continued.)

ARTICLE V.—*Note on the Taconic System of Emmons;* by T. STERRY HUNT, M.A., F.R.S.

In a notice of the Taconic rocks in the last volume of this Journal, (p. 379,) it was explained that Emmons asserts that in going eastward from the line of fault which brings up the Taconic group to overlie the Trenton and Loraine formations, we meet successively with lower rocks, all dipping eastward, until in the Green Mountain gneiss we have a rock which is older than the Taconic group; so that the newest rocks appear to be at the base, and the oldest at the summit of the series. It was however maintained, in opposition to this view, that the apparent order of superposition from the great fault, going eastward to the Green Mountains is in the main, the true one, and that the black slates of Emmons, which he regards as the newest rock of his series, are really the oldest; while the Green Mountain gneiss is a rock higher in the series than any of those to the west of it.

These propositions we still maintain, but in explaining what we conceive to be Mr. Emmons' error, we have said that in order to explain this supposed inversion in the succession of the rocks, he

imagines a great overturn of the whole series in question. In this we have been misled by the language of Mr. Emmons, which has caused him to be misinterpreted by others as well. In speaking of the succession of rocks, he uses the term "inverted strata," and Mr. Barrande has spoken of the "overturn (*renversement*) of the whole system." Mr. Marcou, apparently as the interpreter of Emmons, speaks of the strata in question as having been "overturned (*renversées*) on each side of the crystalline and eruptive rocks which occupy the centre of the chain, presenting thus a fan-shaped structure, and all the accidents which accompany a complete overturn of a whole system of strata," so that in going eastward towards the centre of the chain, we find that the most recent strata appear to be placed beneath the most ancient, "in consequence of an overturn (*renversement*)." *Comptes Rendus de l'Acad.* xliii. 804.

Now in justice to Mr. Emmons it should be said, that despite his use of the expression "inverted strata," he has never maintained any inversion or overturn, as a careful examination of his descriptions will show. (*Taconic System.* p. 17). He supposes that during the accumulation of the Taconic rocks, the gneiss which formed the eastern limit of the basin was progressively elevated, so as to successively bring the older members above the ocean from which the sediments were being deposited; and that the upper parts of the formation, such as the black slates, were thus confined to a narrow basin, and never extended far eastward; at the same time he conceives that denudation may have removed large portions of the upper beds. At a subsequent period a series of parallel faults, with upthrows to the eastward, is supposed to have broken the strata, given them their eastward dip, and caused the older beds to overlap the inner; thus giving rise not to an inversion of the strata, but to an apparent inverted succession. Now we find in Canada abundant evidence that the slates which Emmons regards as the newest, are really near the base of the series, and cannot consequently admit his hypothesis to explain an order of things which we conceive to have no existence.

The careful study of the region in question shows, that although such a great upthrow and overlap does bring the Quebec group to the surface from beneath the higher rocks, to the east of this fault undulations, overturns, and downthrows to the eastward, diversify, with eastern upthrows, the structure of this complicated region. The gneiss of the Green Mountains, like that of the Scottish Highlands and like the granite of the summits of the Alps, is the newest

rock of the chain, the structure of all these mountain regions being synclinal, as we have endeavoured to show in the case of the Alps, (*Silliman's Journal* (2) xxix. 118,) and as Sir Roderick Murchison has beautifully represented in his late section across the Scottish Highlands. (See his new Geol. Map of Scotland).

MISCELLANEOUS.

CHROMIC IRON ORE AND ASBESTUS.

We copy from a late number of the *Chemical News*, the following notice of the chromic iron and asbestus from the vicinity of Baltimore, lately imported into England. It is known to many of our readers that the Geological Survey has already shewn the existence in several parts of the Eastern Townships, and in Gaspé, of large deposits of this valuable ore, equal in richness to the samples from the United States :—" The amount of sesqui-oxide of chromium in the present ore, as determined by Dr. Genth, is stated to be equivalent to 63 per cent. of *chromic acid*—a mode of expressing the value of the ore by the quantity of chromic acid produced on fusion with an alkali, and not that of the green sesqui-oxide actually contained therein. Ore of this superior description may be obtained in casks ready for shipment, at the rate of about one dollar for each one per cent. of chromic acid per ton, and in quantities of about 200 tons annually. It is, however, considered more judicious to work this ore in admixture with other qualities which are produced in greater abundance,—1500 tons annually,—the average composition of such samples furnishing usually about 50 per cent of chromic acid. The ore last described was accompanied by specimens of asbestus, and of paper containing about one-third proportion of the same. This mineral may be procured at the rate of 1½ cents per pound,—a low price considering the high quality of the article offered. The specimen sent is beautifully white, and the fibres are long and delicate. It has been tried in America for paper-making and for the manufacture of steam-packing, in both of which applications it is said to be very serviceable. Its property of resisting heat, and its bad conducting power, would render this material particularly valuable in connection with steam machinery. The sheet of paper sent is a portion of an experimental manufacture; it burns with flame, leaving a white incombustible residue, which, with careful management, retains the form of the original sheet; the weight of ash amounting precisely to 30 per cent."

MONTHLY METEOROLOGICAL REGISTER, ST. MARTINS, ISLE JESUS, CANADA EAST, (NINE MILES WEST OF MONTREAL,) FOR THE MONTH OF DECEMBER, 1861.

Latitude, 45 degrees 32 minutes North. Longitude, 73 degrees 36 minutes West. Height above the level of the Sea, 118 feet.

BY CHARLES SMALLWOOD, M.D., LL.D.

Day of Month	Barometer—corrected and reduced to 32° F. (English inches.)			Temperature of the Air.—F.			Tension of Aqueous Vapour.			Humidity of the Atmosphere.			Direction of Wind.			Horizontal Movement in 24 hours. In miles.	OZONE. Mean amount of, in tenths.	RAIN. Amount of, in inches.	SNOW. Amount of, in inches.	WEATHER, CLOUDS, REMARKS, &c. &c. [A cloudy sky is represented by 10, a cloudless one by 0.]		
	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.					6 a. m.	2 p. m.	10 p. m.
1	29.774	29.670	29.514	16.4	28.1	25.4	.068	.120	.117	.75	.80	.87	S. S. E.	N. E. by E.	N. E. by E.	122.60	4.0	....	1.60	Slight Snow.	Snow.	Snow.
2	561	617	719	19.6	26.2	16.5	.093	.105	.068	.92	.75	.75	W. S. W.	W. S. W.	W. S. W.	338.50	3.0	....	0.57	Cu. Str. 8.	C. C. Str. 10.	Clear.
3	784	862	30.147	7.6	22.2	8.3	.054	.084	.050	.88	.71	.82	W. S. W.	W.	S. W. W.	151.30	3.0	....	....	C. C. Str. 10.	Clear.	"
4	933	962	29.874	−3.2	24.0	24.2	.030	.083	.100	.80	.66	.80	W. S W.	S. W. by S.	S. by W.	27.30	2.5	....	....	Clear.	C. C. Str. 4.	Cu. Str. 10.
5	952	30.147	30.030	20.0	34.0	29.2	.091	.162	.140	.85	.84	.86	W. by S.	W.	S.	16.20	3.5	....	....	Cu. Str. 10.	Cirr. Str. 10.	" 10.
6	30.329	244	256	21.2	31.6	32.0	.096	.149	.162	.85	.84	.89	N. E by E.	N. E. by E.	E. S. E.	154.70	4.0	Inapp.	....	" 10.	" 10.	" 10.
7	039	29.947	29.824	36.2	39.2	39.0	.191	.216	.223	.90	.91	.98	S. by W.	S. S. E.	S.	18.50	3.5	....	....	Cirr. Str. 4.	" 10.	Rain.
8	29.681	754	815	39.1	46.9	37.8	.220	.262	.211	.92	.84	.94	S. W.	W. S. W.	N.	71.70	3.5	0.600	....	Fog.	Hazy.	Cu. Str. 10.
9	891	900	857	34.6	39.0	25.2	.169	.195	.182	.84	.82	.89	E.	S. W.	S. E. E.	23.20	3.5	....	....	Cu. Str. 10.	Cu. Str. 10.	" 10.
10	800	744	594	34.0	36.0	36.1	.182	.177	.191	.95	.85	.90	N. E. by N.	N. E. by E.	S. W.	121.40	3.5	0.126	....	" 10.	" 10.	Cir. Cu. Str, 8.
11	747	30.000	30.250	34.2	33.0	15.0	.175	.079	.061	.89	.65	.76	N. by W.	W. N. W.	N. W.	651.90	5.0	0.380	....	Rain.	Clear.	Clear.
12	30.341	351	372	15.2	26.0	19.1	.069	.128	.074	.71	.87	.69	S by E.	S. S. W.	S.	60.10	3.0	....	Inapp.	Cu. Str. 10.	Cu. Str. 10.	Clear.
13	149	137	101	28.9	27.3	31.1	.123	.192	.155	.77	.88	.89	S. S. W.	W. S. W.	S. S. W.	47.00	4.0	....	....	" 4.	" 8.	Cirr. Str. Lunar Halo.
14	29.870	29.746	29.749	27.1	42.2	37.6	.129	.199	.171	.88	.74	.76	S. S. W.	W. S. W.	W.	119.20	2.0	....	....	C. C. Str. 8.	Cu. Cir. 4.	Clear. Inapp. halo Aurora Boreal.
15	30.137	30.101	30.051	16.4	26.0	25.6	.074	.111	.111	.83	.81	.81	N. W.	N. by W.	W.	473.20	2.5	....	....	Cirr. Str. 4.	Clear.	C. C. Str. 10.
16	29.600	29.714	29.820	24.1	30.1	29.1	.110	.130	.129	.86	.78	.82	S. W.	W.	N. N. E.	224.40	2.5	....	....	Cu. Str. 10.	C. C. Str. 6. S. H.	Clear.
17	30.191	30.100	847	10.7	25.7	26.0	.048	.110	.123	.69	.80	.87	S. E. by E.	S. W. by S.	E. by S.	74.70	3.5	....	....	Clear.	Cirr. Cu. 4. 1p. H.	Cirr. 4. and Halo.
18	29.654	29.863	30.114	30.0	33.0	15.1	.136	.150	.161	.83	.80	.73	S. W. by W	N. by W.	N. E. by E.	221.50	3.0	....	....	Cu. Str. 10.	Clear.	Clear.
19	987	684	29.611	9.0	19.8	26.3	.051	.081	.118	.77	.77	.83	E. S. E.	N. E. by E.	S. S. E.	49.70	3.5	....	Inapp.	" 10.	Snow.	Sleet.
20	667	914	30.054	20.0	10.0	0.0	.191	.089	.052	.85	.57	.70	W. by N.	W. N. W.	W.	247.20	4.8	....	....	" 4.	Cu. Str. 4.	Clear. Faint Aurora Borealis.
21	30.199	30.224	269	−10.0	4.1	8.1	.022	.041	.051	.78	.74	.77	W.	S. W.	S. S. W.	845.89	2.0	....	....	Clear.	Clear.	Cu. Str. 8.
22	257	162	114	12.0	28.0	21.0	.051	.123	.096	.70	.81	.95	S. S. W.	S. S. W.	E. S. E.	85.80	3.0	....	....	Str. 2.	Cu. Str. 9.	" 4.
23	29.714	29.437	29.378	17.0	20.9	23.0	.078	.091	.112	.83	.85	.93	N. E. by E.	N. E. by E.	N. E. by E.	240.50	5.5	....	2.50	Snow.	Snow.	Snow.
24	514	619	868	14.1	16.6	0.5	.070	.054	.036	.82	.58	.84	W.	W. by S.	W. by S.	563.70	4.5	....	....	Cu. Str. 10.	Cu. Str. 10.	Cu. Str. 10.
25	30.028	30.079	30.220	−7.3	10.0	0.6	.020	.045	.036	.64	.68	.84	W. by S.	W. S W.	S. S. E.	69.90	2.0	....	....	Clear.	" 4.	Clear.
26	220	045	000	−9.1	11.0	26.3	.024	.042	.123	.79	.59	.87	N. E by E.	N. E. by E.	S. by E.	55.80	4.0	....	....	C. C. Str. 4.	C. C. Str. 10. F. halo.	Sleet.
27	29.502	29.560	29.984	34.0	25.0	9.1	.175	.100	.051	.74	.77	.83	S. S. W.	W.	W.	582.10	4.5	0.210	....	Rain.	" 10.	Cu. Str. 10.
28	30.277	30.179	30.210	−4.0	9.0	1.0	.031	.051	.038	.83	.77	.85	W. S. W.	W. S. W.	S. W. by W	420.90	2.0	....	....	Clear.	Clear.	Clear.
29	181	29.924	29.944	−1.0	15.1	10.0	.028	.046	.084	.68	.55	.78	S. E.	E. by S.	S. by W.	17.40	2.0	....	....	C. C. Str. 8.	Cu. Str. 8.	Cu. Str. 10.
30	29.736	953	30.054	8.1	22.2	5.0	.048	.084	.041	.77	.71	.74	W. S. W.	W.	S. S. W.	162.60	2.0	....	0.50	Cu. Str. 10.	" 10.	" 10.
31	894	757	29.891	8.1	21.0	14.1	.048	.080	.067	.77	.71	.81	S. by E.	S. E.	N. N. E.	6.10	4.0	....	3.10	" 10.	Snow.	Snow.

REPORT FOR THE MONTH OF JANUARY, 1862.

Day of Month	Barometer—corrected and reduced to 32° F. (English inches.)			Temperature of the Air.—F.			Tension of Aqueous Vapour.			Humidity of the Atmosphere.			Direction of Wind.			Horizontal Movement in 24 hours. In miles.	OZONE. Mean amount of	RAIN. Amount of, in inches.	SNOW. Amount of, in inches.	WEATHER, CLOUDS, REMARKS, &c., &c. [A cloudy sky is represented by 10, a cloudless one by 0.]		
	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a.m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.					6 a. m.	2. p. m.	10 p. m.
1	29.482	28.863	29.268	19.1	26.0	10.0	.087	.123	.045	.84	.87	.68	N. E. by E.	N. W. by W.	W.	230.80	4.0	Inapp.	1.70	Snow.	Rain.	Cirr. Str. 10.
2	747	29.799	944	−6.5	6.1	−1.6	.026	.035	.034	.80	.61	.84	W. by N.	W. N. W.	W. N. W.	184.80	3.0	....	....	Clear.	Clear.	Clear. Faint Aurora Borealis.
3	998	985	997	−11.4	2.3	−7.0	.014	.034	.022	.53	.71	.69	W. N. W.	W. by N.	W. by N.	139.80	2.0	....	....	"	"	"
4	903	840	918	−16.1	−1.0	−6.6	.009	.028	.026	.43	.68	.80	W. by N.	W. by N.	W. by N.	111.80	2.0	....	....	"	"	"
5	953	917	917	−11.5	3.0	−2.9	.020	.042	.032	.76	.86	.83	W. by S.	W. by N.	W. S. W.	95.30	2.0	....	....			
6	765	779	784	−10.5	4.7	3.7	.021	.044	.046	.77	.84	.87	N. E. by E.	N. E. by E.	S. S. E.	0.00	3.0	....	....	Cu. Str. 6.	Cu. Str. 4.	Cu. Str. 8.
7	870	931	30.186	8.0	24.0	7.0	.018	.100	.048	.77	.79	.77	W. by S.	W.	W.	1.00	4.0	....	0.75	Snow.	Clear.	Clear.
8	30.317	30.101	29.824	−8.0	22.2	24.4	.020	.084	.111	.66	.71	.86	W.	S. S. E.	S. S. W.	37.00	4.5	....	....	Hoar Frost.	Cu Str. 10.	Cu. Str. 10.
9	29.804	29.797	811	30.0	37.0	38.0	.148	.184	.177	.89	.85	.85	S. S. W.	W. by S.	W. by S.	83.10	3.0	....	0.75	Cu. Str. 10.		" 10.
10	752	450	319	19.2	21.1	36.2	.087	.096	.191	.84	.85	.90	E. by S.	N. E. by E.	W.	177.90	3.5	Inapp.	....	" 10.	Rain.	" 10.
11	30.088	30.028	30.007	−9.4	1.3	−3.6	.022	.036	.031	.76	.72	.83	W. by N.	N. E	N. E. by E.	147.30	2.0	....	....	Clear.	C. C. Str. 4.	C. C. Str. 8.
12	29.510	29.328	29.376	−1.0	14.2	18.4	.034	.065	.093	.84	.79	.02	N. E. by E.	N. E. by E.	S. W.	139.20	4.0	Inapp.	3.00	Snow.	Snow.	Cu. Str. 10.
13	925	30.188	30.419	−1.0	−1.2	−10.3	.036	.028	.015	.84	.68	.55	W. N. W.	N. W. by W	W.	429.60	3.0	....	....	Clear.	Clear.	Clear. Aurora Borealis.
14	30.561	565	568	−27.7	0.0	−5.0	.009	.026	.025	.89	.56	.80	N. E. by E.	N. E. by E.	N. E. by E.	3.90	3.0	....	....		"	C. C. Str. 0. Lunar Halo.
15	651	29.774	29.510	−2.0	15.4	17.0	.030	.065	.073	.80	.74	.83	N. E. by E.	N. E. by E.	N. E. by E.	202.80	4.5	Inapp.	7.15	Snow.	Snow.	Cu. Str. 10.
16	29.698	749	30.025	19.0	17.4	−0.6	.082	.072	.036	.84	.75	.84	W.	W.		225.80	4.5	....	....	Cu. Str. 4.	Cu. Str. 4.	Clear.
17	30.367	30.278	295	−2.0	17.4	12.3	.034	.072	.060	.84	.75	.80	S. S. W.	S.	S. by W.	0.00	3.5	....	Inapp.	" 10.	" 4.	C. Cum. 4.
18	228	054	036	15.1	21.2	16.1	.070	.093	.074	.81	.80	.83	S. S E.	N. E. by E.	N. E. by E.	13.10	5.0	....	6.14	" 10.	Snow.	Cu. Str. 10
19	29.995	29.884	29.927	3.0	20.1	19.2	.041	.081	.087	.74	.77	.84	N. E. by E.	N. E. by E.	N. E. by E.	205.40	5.5	....	1.01		Cu. Str. 10.	" 19.
20	894	851	967	17.1	20.1	19.1	.098	.091	.091	.83	.85	.85	N. E. by E.	N. E. by E.	N. E. by E.	366.10	5.5	....	7.00	Snow.	Snow.	Snow.
21	30.119	30.176	30.097	15.4	13.0	10.1	.070	.063	.054	.80	.81	.78	N. E. by E.	N. E. by E.	N. E. by E.	194.20	1.5	....	....	Clear.	Clear.	Clear.
22	080	151	114	8.4	18.1	17.1	.048	.082	.078	.77	.84	.83	N. E by E.	N. E. by E.	N. E. by E.	48.40	3.0	....	0.75	C. C. Str. 10.	Snow.	Snow.
23	004	052	139	17.4	33.6	25.0	.074	.143	.117	.80	.79	.87	S. S. W.	S. S. W.	N. E. by N.	1.00	2.5	....	....	Cu. Str. 10.	C. C. Str. 4.	Cu. Str. 10.
24	241	019	174	8.4	22.1	10.6	.048	.084	.048	.77	.71	.69	S. S. E.	N. E. by E.	N. E. by E.	0.00	1.5	....	....	Hazy.	Clear.	" 4. Faint A. Bor.
25	29.948	29.741	29.618	14.1	24.1	18.2	.067	.111	.082	.81	.86	.84	N. E. by E.	N. E. by E.	N. E. by E.	91.40	3.0	....	6.14	Cu. Str. 10.	Snow.	Snow.
26	571	647	867	20.0	25.2	17.2	.091	.117	.068	.85	.86	.75	W. by S.	W. N. W.	W.	223.40	3.5	....	1.47	Snow.	Cu. Str. 4.	Clear.
27	30.184	30.314	30.066	12.1	12.8	0.0	.060	.054	.038	.80	.71	.85	W. N. W.	W. N. W.	W. N. W.	476.44	1.0	....	....	Cu. Str. 4.	Clear.	"
28	414	274	253	−15.5	12.1	0.0	.014	.045	.032	.70	.60	.70	W. by N.	W.	W.	100.80	1.0	....	....	Hoar Frost.	"	Cu. Str. 10.
29	29.886	29.814	29.874	3.0	17.1	16.0	.036	.078	.074	.72	.83	.85	N. E. by E.	N. W. by W.	W. N. by W	133.70	1.8	....	Inapp.	Snow.	Sleet.	" 10.
30	954	967	30.050	16.1	32.1	23.2	.074	.143	.089	.85	.79	.72	S. S. W.	W. S. W.	W. N. W.	1.30	1.5	....	....	Cu. Str. 10.	Clear.	" 10.
31	30.315	30.331	345	2.0	16.1	1.0	.032	.059	.032	.70	.65	.70	W. N. W.	W. N. W.	W. N. W.	39.60	1.5	....	....	Clear.	"	Clear. Zodiacal light bright.

REMARKS FOR DECEMBER, 1861.

Barometer.......
- Highest, the 12th day, 30·372 inches.
- Lowest, the 23rd day, 29.378 "
- Monthly Mean, 29.892 "
- " Range, 0.994 "

Thermometer...
- Highest, the 8th day, 46°0.
- Lowest, the 21st day,—10°0.
- Monthly Mean, 20°54.
- Monthly Range, 56°9.

Greatest intensity of the Sun's rays, 69°8.
Lowest point of Terrestrial radiation,—11°7.
Mean of Humidity, .796.
Rain fell on 5 days, amounting to 1.306 inches; it was raining 31 hours and was accompanied by Thunder on 1 day.

Snow fell on 7 days to 8.27 inches; it was snowing 80 hours 55 minutes.
Most prevalent wind, W. S. W.
Least prevalent wind, the N.
Most windy day the 11th day, mean miles per hour, 27.18.
Least windy day the 31st day, mean miles per hour, 0.25.
Aurora Borealis visible on 3 nights.
Solar Halo visible on 3 days.
Lunar Halo visible on 3 nights.
The Electrical state of the Atmosphere has indicated high intensity.
Winter fairly set in on the 23rd day.

REMARKS FOR JANUARY, 1862.

Barometer. ......
- Highest, the 27th day, 30.666 inches.
- Lowest, the 1st day, 28.863 "
- Monthly Mean, 29.845 "
- Monthly Range, 1.803 "

Thermometer.
- Highest, the 9th day, 37°0.
- Lowest, the 14th day,—27°7.
- Monthly Mean, 9°48.
- Monthly Range, 64°7.

Greatest intensity of the Sun's rays, 45°1.
Lowest point of Terrestrial radiation,—29°2.
Mean of humidity, ·788.
Rain fell on 4 days, inappreciable.

Snow fell on 13 days amounting to 36·85 inches. It was snowing 95 hours and 28 minutes.
Most prevalent wind, N. E. by E.
Least prevalent wind, S.
Most windy day, the 27th day; mean miles per hour, 19,85.
Least windy day, the 17th day; Calm.
Aurora Borealis visible on 3 nights.
Lunar Halo very bright on 1 night.
Zodiacal light bright (but Venus presents an early and well defined view.)
Encke's comet was visible.
The Electrical state of the Atmosphere has indicated high intensity.

the weight of ash amounting precisely to 30 per cent."

THE

CANADIAN

NATURALIST AND GEOLOGIST.

VOL. VII. APRIL, 1862. No. 2.

ARTICLE VI.—*Notes on the Flora of the White Mountains, in its Geographical and Geological relations.* By J. W. DAWSON, LL.D., F.G.S.

(Read before the Montreal History Society.)

The group of the White Mountains is the culminating point of the northern division of the great Appalachian range, extending from Tennessee to Gaspé in a south-west and north-east direction, and constituting the breast-bone of the North American continent. This great ridge or succession of ridges has its highest peaks near its southern extremity, in the Black Mountains; but these are little higher than their northern rivals, which at least hold the undisputed distinction of being the highest hills in north-eastern America. As Guyot * has well remarked, the White Mountains do not occur in the general line of the chain, but rather on its eastern side. The central point of the range, represented by the Green Mountains and their continuation, describes a great curve from Gaspé to the valley of the Hudson, and opposite the middle of the concave side of this curved line towers the almost isolated group of the White Hills. On the other side is the narrow valley of Lake Champlain, and beyond this the great isolated mass of the Adirondack Mountains, nearly approaching in the altitude of their highest peaks, and greatly exceeding in their geological

* Silliman's Journal.

age, the opposite White Mountain group. The Appalachian range is thus in this part of its course, supported on either side by outliers higher than itself.

My present purpose is not to give a general geographical or geological sketch of the White Mountains, but to direct attention to the vegetation which clothes their summits, and its relation to the history of the mountains themselves. For this purpose I may first shortly describe the appearances presented in ascending the highest of them, Mount Washington, and then turn to the special points to which these notes relate.

In approaching Mount Washington by the Grand Trunk Railway, the traveller has ascended from the valley of the St. Lawrence to a height of 802 feet at the Alpine House at Gorham. Thence in a distance of about 8 miles along the bank of the Peabody River, to the Glen House, he ascends to the elevation of 1632 feet above the sea; and it is here or immediately opposite the Glen House, that the actual ascent begins. The distance from the Peabody River, opposite the hotel, to the summit is nine miles, and in this distance we ascend 4656 feet, the total height being 6288 feet above the sea.* Formerly only a bridle path led up this ascent; but last year a regularly graded and admirably finished carriage road was opened, by which visitors can drive comfortably to the top and back without any of the fatigue formerly experienced. This enterprise, almost worthy of comparison with the great roads over the passes of the Alps, was undertaken several years ago by a joint-stock company, and has at length been finished, at a cost, I believe, of $40,000, the interest on which it is hoped will be paid by the tolls levied on travellers, whose annual numbers are estimated at about 5000 for this road. This royal road to the summit is however by far too democratic for the taste of some visitors, who mourn the olden days of ponies, guides, and adventures; and though it gives an excellent view of the geological structure of the mountain, it does not afford a good opportunity for the study of the alpine flora, which is one of the chief attractions of Mount Washington. For this reason, though I availed myself of the new road for gaining a general idea of the features of the group, I determined to ascend by Tuckerman's ravine, a great chasm in the mountain side, named in honour of the indefatigable botanist of the North American

* According to Guyot, but some recent surveys make it a little higher.

lichens.* I was aided in this by the kindness of a gentleman of Boston, well acquainted with these hills, and passionately fond of their scenery. Our party, in addition to this gentleman and myself, consisted of two ladies, two children, and two experienced guides, whose services were of the utmost importance, not only in indicating the path, but in removing windfalls and other obstructions, and in assisting members of the party over difficult and dangerous places.

We followed the carriage road for two miles, and then struck off to the left by a bridle path that seemed not to to have been used for several years—the gentlemen and guides on foot, the ladies and children mounted on the sure-footed ponies used in these ascents. Our path wound around a spur of the mountain, over rocky and uneven ground, much of the rock being mica slate, with beautiful cruciform crystals of andalusite, which seemed larger and finer here than in any other part of the mountain which I visited. At first the vegetation was not materially different from that of the lower grounds, but as we gradually ascended we entered the "evergreen zone," and passed through dense thickets of small spruces and firs, the ground beneath which was carpeted with moss, and studded with an immense profusion of the delicate little mountain wood-sorrel (*Oxalis acetosella*), a characteristic plant of wooded hills on both sides of the Atlantic, and which I had not before seen in such profusion since I had roamed on the hills of Lochaber Lake in Nova Scotia. Other herbaceous plants were rare, except ferns and club-mosses; but we picked up an aster (*A. acuminatus*), a golden rod, (*Solidago thyrsoidea*), and the very pretty tway blade (*Listera cordata*).

In ascending the mountain directly, the spruces of this zone gradually degenerate, until they present the appearance of little gnarled bushes, flat on top and closely matted together, so that except where paths have been cut, it is almost impossible to penetrate among them. Finally they lie flat on the ground, and become so small that, as Lyell remarks, the rein-deer moss may be seen to overtop the spruces. This dwarfing of the spruces and firs is the effect of adverse circumstances, and of their struggle to extend their range toward the summit. Year by year they

* Dr. Bigelow and Prof. Tuckerman have been the chief botanical explorers of the White Mountains; though Pursh was the first to determine some of the more interesting plants, and Peck, Booth, Oakes and others, deserve honourable mention.

stretch forth their roots and branches, bending themselves to the ground, clinging to the bare rocks, and availing themselves of every chasm and fissure that may cover their advance: but the conditions of the case are against them. If their front advances in summer it is driven back in winter, and if in a succession of mild seasons they are able to gain a little ground, less favourable seasons recur, and wither or destroy the holders of their advanced positions. For thousands of years the spruces and firs have striven in this hopeless escalade, but about 4000 feet above the sea seems to be the limit of their advance, and unless the climate shall change, or these trees acquire a new plasticity of constitution, the genus *Abies* can never displace the hardier alpine inhabitants above, and plant its standard on the summit of Mount Washington.

I was struck by the similarity of this dwarfing of the upper edges of the spruce woods, to that which I have often observed on the exposed northern coasts of Cape Breton and Prince Edward Island, where the woods often gradually diminish in height toward the beach or the edge of a cliff, till the external row of plants clings closely to the soil, or rises above it only a few inches. The causes are the same, but the appearance is more marked on the mountain than on the coast.

On the path which we followed, before we reached the upper limit of trees, we arrived at the base of a stupendous cliff, forming the termination of a promontory or spur of the mountain, separating Tuckerman's ravine from another deep depression known as the Great Gulf. From the top of this precipice poured a little cascade that lost itself in spray long before it touched the tops of the trees below. The view at this place was the most impressive that it was my fortune to see in these hills.

Opposite the mouth of the Great Gulf, and I suppose at a height of about 3000 feet, is a little pond known as Hermit Lake. It is nearly circular, and appears to be retained by a ridge of stones and gravel, perhaps an old moraine or sea beach. On its margin piped a solitary sand-piper, a few dragon flies flitted over its surface, and tadpoles in the bottom indicated that some species of frog dwells in its waters. High over head and skirting the edges f the precipices, soared an eagle, intent no doubt on the hares that frequent the thickets of the ravines.

Before we reached Hermit Lake we had been obliged to leave our horses, and now we turned aside to the left and entered

Tuckerman's ravine, where there is no path, but merely the bed of a brook, whose cold clear water tumbles in a succession of cascades over huge polished masses of white gneiss, while on both sides of it the bottom of the ravine is occupied by dense and almost impenetrable thickets of the mountain alder (*Alnus viridis.*)

Tuckerman's ravine has been formed originally either by a subsidence of a portion of the mountain side or by the action of the sea. It is, like most of the ravines and "gulfs" of these hills, a deep cut or depression bounded by precipitous sides, and terminating at the top in a similarly precipitous manner. It must at one period have been in part filled with boulder clay, steep banks of which still remain in places on its sides; and extensive landslips have occurred, by which portions of the limiting cliffs have been thrown toward the centre of the valley, in large piles of angular blocks of gneiss and mica slate, in the spaces between which grow gnarled birches and spruces that must be used as ladders and bridges whereby to scramble from block to block, by every one who would cross or ascend one of these rivers of stones.

At the head of the ravine we paused to rest, to admire the wild prospect presented by the ravine and its precipitous sides, and to collect the numerous plants that flower on the surrounding slopes and precipices. Here on the 19th of August were several large patches of snow, one of them about an hundred yards in length. From the precipice at the head of the ravine, poured hundreds of little rills, and several of them collecting into a brook, had excavated in the largest mass of snow a long tunnel or cavern with an arched and groined roof. Under the front of this we took our mid-day meal, with the hot August sun pouring its rays in front of us, and icy water gurgling among the stones at our feet. Around the margin of the snow the vegetation presented precisely the same appearances which are seen in the low country in March and April, when the snow banks have just disappeared—the old grass bleached and whitened, and many perennial plants sending up blanched shoots which had not yet experienced the influence of the sunlight.

The vegetation at the head of this ravine and on the precipices that overhang it, presents a remarkable mixture of lowland and mountain species. The head of the ravine is not so high as the limit of trees already stated, but its steep sides rise abruptly to a plateau of 5000 feet in height intervening between Mount Wash-

ington and Mount Munro, and on which are the dark ponds or tarns known as the Lakes of the Clouds, forming the sources of the Amonoosook river, which flows in the opposite direction. From this plateau many alpine plants stretch downward into the ravine, while lowland plants availing themselves of the shelter and moisture of this cul-de-sac, climb boldly upward almost to the higher plateau. Other species again occur here which are found neither on the exposed alpine summits and ridges nor in the low country. Conspicuous among the hardy climbers are two coarse and poisonous weeds of the river valleys, that look like intruders into the company of the more dwarfish alpine plants;—the cow-parsnip (*Heracleum lanatum*) and the white hellebore (*Veratrum viride*). Both of these plants were seen struggling up through the ground at the margin of the snow, and climbing up moist hollows almost to the top of the precipices. Some specimens of the latter were crowded with the infant caterpilars of a mountain butterfly or moth. Less conspicuous, and better suited to the surrounding vegetation, were the bluets (*Oldenlandia cœrulea*), now in blossom here as they had been months before in the low country, the dwarf cornel (*Cornus Canadensis*), and the twin-flower (*Linnœa borealis*), the latter reaching quite to the plateau of the Lake of the Clouds, and entering into undisputed companionship with the truly alpine plants, though it is also found at Gorham four thousand feet lower.

Of the plants which seemed to be confined or nearly so to the upper part of the ravine, one of the most interesting was the northern painted cup, (*Castelleia septentrionalis*) a plant which abounds on the coast of Labrador and extends thence through all Arctic North America to the Rocky Mountains, and is perhaps identical with the *C. Sibirica* of Northern Asia and the *C. pallida* of Northern Europe. Large beds of it were covered with their pale yellow blossoms on the precipitous banks overhanging the head of the ravine. With the painted cup and here alone, was another beautiful species of a very different order, the northern green orchis, (*Platanthera hyperborea*) a plant which occurs, though rarely, in Canada, but is more abundant to the northward. Here also occurred, Peck's geum, (*G. radiatum, var.*), *Arnica mollis*, and several other interesting plants.

Of the Alpine plants which descend into the ravine, the most interesting was the Greenland sandwort, (*Arenaria* (*Alsine*) *Groenlandica*) which was blooming abundantly, with its clusters

of delicate white flowers, on the very summit of the mountain, and could be found here and there by the side of the brook in the bottom of the ravine.

Clambering by a steep and dangerous path up the right side of the ravine, we reach almost at once the limit beyond which the ordinary flora of New England can extend no longer, and are in the presence of a new group of plants comparable with those of Labrador and Greenland. Here, on the plateau of the Lake of the Clouds, the traveller who has ascended the giddy precipices overhanging Tuckerman's ravine, is glad to pause that he may contemplate the features of the new region which he has reached. We have left the snow behind us, except a small patch which lingers on the shady side of Mount Munro; for it is only in the ravines into which it has drifted an hundred feet deep or more, that it can withstand the summer heat until August. We stand on a dreary waste of hard angular blocks of mica slate and gneiss, that lie in rude ridges as if they had been roughly raked-up by Titans who might have been trying to pile Monro upon Washington; but which seem to be merely the remains of the original outcropping edges of the rocks broken up by the frost, but not disturbed or rounded by water. Behind us is the deep trench-like ravine out of which we have climbed: on the left hand a long row of secondary summits stretching out from Mount Washington to the south-westward, and designated by the names of a series of American statesmen. In front this range descends abruptly in great wooded spurs or buttresses to the valley of the Amonoosook which shines in silvery spots through the trees far below. On our right hand towers the peak of Mount Washington, still more than a thousand feet above us, and covered with angular blocks, as if it were a pile of fragments rather than a solid rock. These stones all around and up to the summit of the mountain, are tinted pale green by the map lichen (*Lecidea Geographica*) which tinges in the same way the alpine summits of European mountains. Between the blocks and on their sheltered sides nestle the alpine flowering plants, of which 20 species or more may be collected on this shoulder of the mountain, and some of which extend themselves to the very summit, where *Alsine Grœnlandica* and the little tufts of deep green leaves of *Diapensia Lapponica* with a few Carices seem to luxuriate. Animal life accompanies these plants to the summit, near which I saw a family of the snow bird (*Plectrophanes nivalis*,) evidently summer residents

here, and a number of insects, conspicuous among which was a brown butterfly of the genus *Hipparchia*. Shortly before sundown, when the thermometer at the summit house was fast settling toward the freezing point, a number of swallows were hawking for flies at a great height above the highest peak. To what species they belonged I could not ascertain. Possibly the cliff swallows find breeding places in the sides of the ravines, and rise over the hill top to bask in the sunbeams, after the mountain has thrown its shadows over their homes.

To return to the alpine flora which is peculiar to the peaks of these mountains—are the species comprising it autochthones originating on these hill tops and confined to them, or are they plants occurring elsewhere, and if so where; and how and when did they migrate to their present abodes? These are questions which must occur to every one interested in geology, botany, or physical geography. They have been answered in various ways; but without entering into controversy, I shall merely state a few facts, bearing on and illustrating that view which I myself prefer.

Not one of the alpine plants of Mount Washington is peculiar to the place. Nearly all of them are distinct from the plants of the neighboring lowlands, but they occur on other hills of New England and New York, and on the distant coasts of Labrador and Greenland, and some of them are distributed over the Arctic regions of Europe, Asia and America. In short they are stragglers from that Arctic flora which encompasses the north polar region, and extends in promontories and islands, along the high cold mountain summits far to the southward.

Some of the humble flowerless plants of these hills are of nearly world wide distribution. I have already noticed the pale green map lichen which tints the rocks of the Pyrenees, the Alps, and the Scottish Highlands; and the curious ring lichen (*Parmelia centrifuga*) paints its conspicuous rings and arcs of circles alike on Mount Washington and the Scottish hills. A little club moss (*Lycopodium selago*) is not only widely distributed over the northern hemisphere, but Hooker has recognised it in the Antarctic regions. Not long ago we unrolled in Montreal an Egyptian mummy preserved in the oldest style of embalming, and found that, to preserve the odour of the spices, quantities of a lichen (*Evernia furfuracea*) had been wrapped around the body and had no doubt been imported into Egypt from Lebanon or the hills of Macedonia for such uses. Yet the specimens

from this old mummy were at once recognised by Professor Tuckerman as identical with this species, as it occurs on the White Hills and on Katahdin in Maine. These facts are however easily explicable in comparison with those that relate to the flowering plants.

The spores of lichens and mosses float lighter than the lightest down in the air, and may be wafted over land and sea, and dropped everywhere to grow where conditions may be favourable. Had the Egyptian embalmer used some of the first created specimens of *Evernia furfuracea*, it might easily within the three thousand years or so since his work was done, have floated round the world and established itself on the White Hills. But, as we shall see, neither the time nor means would suffice for the flowering plants. The only available present agency for the transmission of these would be in the crops or plumage of the migratory birds; and when we consider how few of these on their migrations from the north could ever alight on these hills, and the rarity of their carrying seeds in a state fit to vegetate, and further that few of these plants produce fruits edible by birds, or seeds likely to attach themselves to their feathers, the chances become infinitely small of their transmission in this way. The most profitable course of investigation in this and most other cases of apparently unaccountable geographical distribution, is to inquire as to the past geological conditions of the region, and how these may have affected the migrations of plants.

The earlier geological history of these mountains far antedates our existing vegetation. It belongs in the first instance to the Lower Devonian period, in which the materials of these mountains were accumulating, as beds of clay and gravel, in the sea bottom. These were buried under great depths of newer deposits, and were baked and metamorphosed into their present crystalline condition. Again heaved above the sea level, they were hewn by the action of the waves to some degree into their present forms, and constituted part of the nucleus of the American continent in the tertiary period. They were again with all the surrounding land depressed under the sea in the newer Pliocene period, and in the Post-pliocene or modern, slowly upheaved again to their present height. These last changes are those that concern their present flora, and their relations to it are well stated by Sir C. Lyell in the following passages from his interesting account of his ascent of Mount Washington in 1846.

"If we attempt to speculate on the manner in which the peculiar species of plants now established on the highest summits of the White Mountains, were enabled to reach those isolated spots, while none of them are met with in the lower lands around, or for a great distance to the north, we shall find ourselves trying to solve a philosophical problem which requires the aid not of botany alone but of geology, or a knowledge of the geographical changes which immediately preceded the present state of the earth's surface. We have to explain how an Arctic flora consisting of plants specifically identical with those which inhabit lands bordering the sea in the extreme north of America, Europe and Asia, could get to the top of Mount Washington. Now geology teaches us that the species living at present on the earth are older than many parts of our existing continents; that is to say they were created before a large portion of the existing mountains, valleys, plains, lakes, rivers, and seas were formed. That such must be the case in regard to Sicily, I announced my conviction in 1833, after first returning from that country, and a similar conclusion is no less obvious to any naturalist who has studied the structure of North America, and observed the wide area occupied by the modern or glacial deposits, in which marine shells of living but northern species are entombed. It is clear that a great portion of Canada, and the country surrounding the great lakes, was submerged beneath the ocean when recent species of mollusca flourished, of which the fossil remains occur about 500 feet above the level of the sea at Montreal. Lake Champlain was a gulf or strait of the sea at that period, large areas in Maine were under water, and the White Mountains must then have constituted an island or group of islands. Yet as this period is so modern in the earth's history as to belong to the epoch of the existing marine fauna, it is fair to infer that the Arctic flora now contemporary with this was then also established on the globe.

"A careful study of the present distribution of animals and plants over the globe, has led nearly all the best naturalists to the opinion that each species had its origin in a single birth-place, and spread gradually from its original centre to all accessible spots fit for its habitation, by means of the powers of migration given to it from the first. If we adopt this view, or the doctrine of specific centres, there is no difficulty in comprehending how the *Cryptogamous* plants of Siberia, Lapland, Greenland, and Labrador, scaled the heights of Mount Washington, because the

sporules of the fungi, lichens, and mosses, may be wafted through the air for indefinite distances like smoke; and in fact heavier particles are actually known to have been carried for thousands of miles by the wind. But the cause of the occurrence of Arctic plants of the *Phœnogamous* class on the top of the New Hampshire Mountains, specifically identical with those of remote polar regions, is by no means so obvious. They could not in the present condition of the earth affect a passage over the intervening lowlands, because the extreme heat of summer and cold of winter would be fatal to them. We must suppose, therefore, that originally they extended their range in the same way as the plants now inhabiting arctic and antarctic lands disseminate themselves. The innumerable islands in the polar seas are tenanted by the same species of plants, some of which are conveyed as seeds by animals over the ice when the sea is frozen in winter, or by birds; while a still larger number are transported by floating icebergs, on which soil containing the seeds of plants may be carried in a single year for hundreds of miles. A great body of geological evidence has now been brought together to show that this machinery for scattering plants as well as for carrying erratic blocks southward, and polishing and grooving the floor of the ancient ocean, extended in the western hemisphere to lower latitudes than that of the White Mountains. When these last still constituted islands in a sea chilled by the melting of floating ice, we may assume that they were covered entirely by a flora like that now confined to the uppermost or treeless region of the mountains. As the continent grew by the slow upheaval of the land, and the islands gained in height, and the climate around these hills grew milder, the Arctic plants would retreat to higher and higher zones, and finally occupy an elevated area which probably had been at first or in the glacial period, always covered with perpetual snow. Meanwhile the newly formed plains around the base of the mountain, to which northern species of plants could not spread, would be occupied by others migrating from the south, and perhaps by many trees, shrubs, and plants, then first created, and remaining to this day peculiar to North America."

The time to which the above views of Sir C. Lyell would refer the migration of the White Mountain flora, is historically very remote. The changes of level which have submerged the American continent and re-elevated its land, have occupied long periods. Whether with Lyell we measure these periods by the recession

of the Falls of Niagara, or by the growth of the alluvial plain of the Mississippi; or with Agassiz, by the extension of the Peninsula of Florida, or endeavour to estimate the time required for the abrasion and deposition of the great mass of clay that fills the valley of the St. Lawrence, we cannot suppose that less than two or three hundred centuries have elapsed since the alpine plants of the White Mountains were cut off from all connection with their Arctic relatives. Their reign upon the mountain tops not only antedates all human dynasties, but reaches far beyond the creation of man himself and many of his contemporaries.

Positive evidence of the existence of some of these plants during a large portion of this lapse of time, has actually been preserved in the Post-pliocene deposits of Canada. At Green's Creek on the Ottawa, in nodules in the clay containing marine shells, and coeval with the Leda clay of Montreal, there are numerous remains of plants that have been embedded in this clay at a time when the Ottawa valley was a bay or estuary, and when the Adirondack Mountains of New York and the mountains of New England were two rocky islands separated from each other, and from the mainland on the north, by wide arms of the sea. The plants found in these nodules all appear to be of modern species. It is of course not easy to recognise the specific characters in these fragments, but I think I have good evidence of *Potentilla Norvegica*, *P. tridentata*, and possibly *P. Canadensis*; *Populus balsamifera*, *Arctostaphylos uva-ursi*, *Trifolium repens*, *Drosera rotundifolia*, *Potamogeton natans*, and *P. perfoliatum*.* There are also seeds apparently of ranunculaceous plants; grasses and carices, and mosses. Several of these plants are found on the White Mountains, and they are all northern and arctic species. I have no doubt that further examination of these deposits will lead to the discovery of additional examples. This fact, proving as it does the existence of these species at the period in which the theory of Lyell and Forbes requires them to have migrated, is in itself strong corroborative evidence. We can say that some of these species were waiting on the shores of the north, ready to be drifted to the insular spots to the south-west, and that their seeds were actually being washed out to sea by the streams which emptied themselves into the then estuary of the Ottawa.

* These determinations were made from specimens in the collection of the Geological Survey, and from others kindly collected for me by A. Dickson, Esq.

Another aspect of the inquiry which has perhaps not been regarded with sufficient attention, is that which relates to the reduction of temperature, which might be consequent on the great depression of the land which we know to have existed at the close of the tertiary period, a fact on which I have insisted in former papers on the Post-pliocene deposits of Canada.* A very clever writer on the subject of geographical distribution,† has pictured the case of a subsiding continent with the fauna and flora of its lowlands becoming gradually concentrated on the spots which had previously been alpine summits, but now reduced to low and temperate islands. But he has left out of view the fact, that if land still existed in mass in the arctic regions, and if the subsidence was that of land in temperate regions, then on the principles long ago so well stated by Sir C. Lyell, these islands might have a mean temperature far below that of the former plains, and might in consequence be suitable only to such an alpine flora as that which they had previously borne.

Now this is precisely what occurred in the Post-pliocene period. The arctic land remained in great mass, detaching into the sea annual crops of icebergs, which have strewed all the northern hemisphere with boulders : the temperate regions were submerged except a few insular spots. These are the very conditions required for a low mean temperature both in the sea and on the land, and these geographical conditions correspond precisely with the facts as indicated by the fossil animals and plants of the period.

Further, it would be easy to show that the alpine plants of Mount Washington would thrive under such conditions as those supposed, at the sea level ; a low and equable temperature with a moist atmosphere being that which they most desire, and their greatest enemy being the dry parching heat of the plains of the temperate regions. Those of them, such as *Potentilla tridentata*, *Linnœa borealis*, and *Alsine Grœnlandica*, which occur within the limits of the United States, are found under shaded woods, in damp ravines, or on the moist sea coast ; and as we follow the coasts northward, we find these plants on these and on neighboring islands, in lower latitudes than those in which they occur inland. When the summer mists roll around the summit of Mount Washington, it is in every respect the precise counterpart of an

* Canadian Naturalist, Vol. IV. † Wollaston.

islet anywhere on the coast of America from Cape Breton to the arctic seas, and when winter wraps everything in a mantle of snow, all these lands are in like manner under the same conditions. So in the Post-pliocene period, though the islets of the White Mountains may have experienced a less degree of winter cold, they must have had very nearly the same summer temperature as now; and as this is the season of growth for our alpine and arctic plants, it is its character that determines the suitableness of the locality to them.

Those stupendous vicissitudes of land and water which have changed the aspect of continents, and swept into destruction races of gigantic quadrupeds, have dealt gently with these alpine plants, which long ages ago looked out upon a waste of ice-laden waters that had engulfed the Pliocene land with all its inhabitants, as securely as they now look down upon the pleasant valleys of New England. It is curious too that the humbler tenants of the sea have shared a similar exemption. In the clay banks of the Saco, on the shores of Lake Champlain, and mixed with the remains of these very plants in the valley of the Ottawa, are shells that now live in the Gulf of St. Lawrence and on the coast of Maine, intermixed with other species that are now found only in a few bays of the Arctic seas. Just as in the Post-pliocene clays of the Ottawa, the remains of arctic plants are found in the same nodule with those of *Leda truncata*, so now similar associations may be taking place on the coasts at the mouth of the Great Fish River. Truly, in nature as in grace, God hath chosen the weak things of the world to confound those that are mighty, and has left in the earth's geological history, monuments of his respect and regard for the humblest of his works.

We look in vain among the alpine plants so long isolated in these mountains, for any evidence of decided change in specific characters. The alpine plants for ages separated from their arctic brethren, are true to their kinds, and shew little tendency to vary, and none to adapt themselves to new forms in the sunny plains below. This is especially noteworthy in Mount Washington and the neighboring peaks, because the soil of these is the same with that of the valleys below. Several of the plants peculiar to these hills, as the black crow-berry (*Empetrum nigrum*), for instance, even when other conditions are favourable, shun rich calcareous soils, and affect these of granitic origin. In many cases the difference in soil is a sufficient reason for the non-occurrence

of such plants except on certain hills. At Murray Bay, and on the shores of Lake Superior, the plant above named occurs only on the Laurentian gneiss. In Nova Scotia, its relative, *Corema Conradi*, is confined to the granite barrens of the south coast. Many such plants skirt the whole Laurentian range from Labrador to Lake Superior, but refuse to extend themselves over the calcareous plains of Canada. But in the White Hills the soil of the river alluvium is the same micaceous sand that fills the crevices of the rocks in the mountains, and hence there is no obstruction, in so far as soil is concerned, to the diffusion of plants upward and downward in the hills. In like manner there is every possible condition as to moisture and dryness, sunshine and shade, in both localities. These circumstances are of all others the most favourable to such variation as these plants are capable of undergoing. The case is the same with that which Hugh Miller so strongly puts in relation to the species of algæ that occur at different distances below high water mark on the coast of Scotland, each species there attaining a certain limit, and then instead of changing to suit the new conditions, giving place to another. So it is on Mount Washington; and this whether we regard the lowland plants that climb to a certain height and there stop; the plants that are common to the base and summit, or the plants that are confined to the latter.

I have already referred to the evident struggle of the spruces and firs, and the plants associated with them, to ascend the mountain; and the same remark applies to all the plants that one after another cease to appear at various heights from the lower valleys. One by one they become stunted and depauperated, and then cease, without any semblance of an attempt to vary into new and hardier forms. And this must have been proceeding, be it observed, from all those thousands or myriads of years that have elapsed since the elevation of the mountains out of the glacial seas. It is to be observed also that the new plants that occur in ascending, often belong to different genera and families from those left behind, not to closely allied species; and in the few cases in which this last kind of change occurs, there is no graduation into intermediate forms. For instance *Solidago thyrsoidea* and *S. virga-aurea* occur around the base of the mountain, and for some distance up its sides. At the height of four to five thousand feet, the latter only remains, and this in a dwarfish condition. This corresponds to its distribution elsewhere, for according to Richardson it occurs in

lat. 55° to 65° in Arctic America, and according to Hooker it is found in the Rocky Mountains, while it also occurs in the hills of Scotland, and very abundantly in some parts of Norway. In the White Mountains *S. thyrsoidea* prevails toward the base, *S. virga-aurea* toward the summit; and at the top of Tuckerman's ravine I found the former of these golden-rods in blossom, within a few hundred feet of the latter, each preserving its distinctive peculiarities. Much has lately been said of the appearance of specific diversity that results from the breaking up of the continuity of the geographical areas of plants by geological changes; but here we probably have the converse of this. The mountain species is no doubt a part of the older arctic flora, the other belongs to the more modern flora of the plains, and they have met on the sides of the White Hills.

Some hardy species climb from the plains to heights of 5000 feet or more, with scarcely even the usual change of being depauperated, and then suddenly disappear. This is very noteworthy in the case of two woodland plants, the dwarf cornel or pigeon-berry (*Cornus Canadensis*), and the twin-flower (*Linnœa borealis*). The former of these is a plant most widely distributed over northern America, and probably belongs to that newer flora which overspread the continent after its re-elevation. In August this plant in the woods around the base of Mount Washington is loaded with its red berries. At an elevation of four to five thousand feet it may be found in bloom; above this a few plants appear destitute of flowers, dwarfish in aspect, and nipped by cold, and then the species disappears. No doubt the birds that feed on its little drupes have carried it up the mountain, and have sown it a little farther up than the limit of its probable reproductiveness. The beautiful little *Linnœa* is a still more widely distributed plant; for it occurs on the hills of northern Europe, and is found across the whole breadth of the American continent from Nova Scotia to the Columbia River. It is almost beyond question a member of the old arctic flora which colonised the islands of the Post-pliocene sea, and has descended from them on all sides as the land became elevated. This plant also climbs Mount Washington to a height of 5000 feet, and presents precisely the same characters on the top as at the bottom, only losing a little in the length of its stem. Specimens bearing blossoms and quite in the same stage of growth, may be collected at the same time on the highest shoulders of Mount Washington, and on the flats at Gor-

ham. The *Linnœa* in this is true to its designation. For as if it belonged to it to support the reputation of the great systematist after whom it is named, it preserves its specific characters with scarcely a tittle of change throughout all its great range. One cannot see this hardy little survivor of the glacial period, so unchanging yet so gentle, so modest yet so adventurous, so wide in its migrations yet so choice in the selection of the mossy nooks which it adorns with its pendant bells, and renders fragrant with its delicious perfume, without praying that we might in these days of petty distinctions and narrow views, be favoured with more such minds as that of the great Swede, to combine the little details of the knowledge of natural history into grand views of the unity of nature.

Another plant which, being less dependent on shade and shelter than the *Linnœa*, mounts still higher, is the cowberry or foxberry (*Vaccinium vitis-Idœa*). This also is both European and American, and is probably a survivor of the Post-pliocene period. It still occurs in at least one locality in the low country of Massachusetts, and on the coast of Maine. It is found along the granitic coast of Nova Scotia, and extends thence northward to the arctic circle, being found at Great Bear Lake and at Unalaska. This too is a most unchanging species, and the same statement may be made respecting *Rubus Chamœmorus*, the cloud-berry, *Empetrum nigrum*, the black crowberry, *Ledum latifolium*, the Labrador tree, *Potentilla tridentata*, the three toothed cinque-foil, which grows on the coast of Nova Scotia, and is found in the nodules of the Ottawa clay, the same in every detail as on Mount Washington, *Vaccinium uliginosum*, the bog billberry, and *V. cœspitosum*, the dwarf billberry. Several of these too it will be observed, are berry-bearing plants, whose seeds must be deposited in all kinds of localities by birds. Yet they never occur in the warm plains, nor do they show much tendency to vary in the distant and somewhat dissimilar places in which they occur. In the case of most of these species, the most careful, comparison of specimens from Mount Washington with those from Labrador, shows no tittle of difference. When we consider the vast length of time during which such species have existed, and the multiplied vicissitudes through which they have passed, one is tempted to believe that it is the tendency of the "struggle for existence" to confirm and render permanent the characters of species rather than to modify them.

Of the more specially arctic plants which have held their ground unchanged on Mount Washington, the following are some of the principal. *Diapensia Lapponica* in beautiful deep green tufts ascends quite to the summit. It occurs also in the Adirondack Mountains, and on Mount Katahdin in Maine. It is found in Labrador, and according to Hooker, extends north to Whale Island in the Arctic seas; but it is not found west of the Great Fish River. It occurs also on the mountains of Lapland, and is described as the hardiest plant of that bleak region. *Arenaria* (*Alsine*) *Grœnlandica*, the Greenland sandwort, adorns with its clusters of white flowers every sandy crevice in the rocks of the very summit of Mount Washington, and is trodden under foot like grass by the hundreds of careless sight-seers that haunt the peak in summer; though I should add that not a few of them carry off little tufts as a memento of the mountains, along with the fragments of mica which appear to form the ordinary keepsakes of unscientific visitors. It is a most frail and delicate plant, seemingly altogether unsuited to the dangerous pre-eminence which it seeks, yet it loves the bare unsheltered mountain peaks, and when it occurs in the more sheltered ravines, has only its stems a little longer and more slender. It occurs on the Adirondack Mountains and on Katahdin, where—if I may judge from specimens kindly sent to me by Mr. Goodale—it attains to smaller dimensions than on Mount Washington, on the Katskills, and at one place on the sea coast of Maine. I have not seen it in Nova Scotia, but it ranges north to Greenland.

Another of the truly arctic plants is the alpine azalea (*Loiseleuria procumbens*), a densely tufted mountain shrub, with hard glossy leaves, that look as if constructed to brave extremest hardships. It is found on the mountains of Norway, at the height of 3550 feet on the Scottish Hills according to Watson, and according to Fuchs at the height of 7000 feet in the milder climate of the Venetian Alps. In America it is found in Newfoundland, in Labrador, and in the barren grounds from lat. 65° to the extreme arctic islands. Gray does not mention its occurrence elsewhere in the United States than the summits of the White Mountains. A member of the same family of the heaths, the yew-leaved phyllodoce (*P. taxifolia*), presents a still more singular distribution. It is found on all the higher mountains of New England and New York, and occurs also on the mountains of Scotland and Scandinavia, but its only known station in northern

America is, according to Hooker, in Labrador. As many as nine or ten of the alpine plants of the White Mountains belong to the order *Ericaceæ*. Another example from this order is *Rhododendron Lapponicum*, a northern European species, as its name indicates, and scattered over all the high mountains of New England and New York, occurring also in Labrador, on the arctic sea coasts, and the northern part of the Rocky Mountains.

It would be tedious to refer in detail to more of these plants, but I must notice two herbaceous species belonging to different families, but resembling each other in size and habit—the alpine epilobium (*E. alpinum* or *alsinefolium*), and the alpine speedwell (*Veronica alpina*). Both are in the United States confined to the highest mountain tops. Both occur as alpine northern plants in Europe, being found on the Alps, on the Scottish Highlands, and in Scandinavia. Both are found in Labrador, and on the Rocky Mountains, and the *Veronica* extends as far as Greenland. The alpine epilobium is one of the few White Mountain plants that have attained the bad eminence of being regarded as doubtful species. Gray notes as the typical form, that with obtuse and nearly entire leaves, and as a variety, that with acute and slightly toothed leaves, which some other botanists seem to regard as distinct specifically. Thus we find that this little plant has been induced to assume a suspicious degree of variability; yet it is strange that both species or varieties are found growing together, as if the little peculiarities in the form of the leaves were matters of indifference, and not induced by any dire necessities in the struggle for life. Facts of this kind are curious, and not easily explained under the supposition either of specific unity or diversity. For why should this plant vary without necessity, and why should two species so much alike be created for the same locality. Perhaps these two species or varieties, wandering from far distant points of origin, have met here fortuitously, while the lines of migration have been cut off by geological changes, and yet the points of difference are too constant to be removed even after the reason for them has disappeared. If this could be proved, it would afford a strong reason for believing the existence of a real specific diversity in these plants.

I have said nothing of the grasses and sedges of these mountains; but one of them deserves a special notice. It is the alpine herd's grass (*Phleum alpinum*), a humble relation of our common herd's grass. This plant not only occurs on the White Moun-

tains, in arctic America, and on the hills of Scotland and Scandinavia, but has been found on the Mexican Cordillera, and at the Straits of Magellan. The seeds of this grass may perhaps be specially suited for transportation by water as well as by land. It is observed in Nova Scotia that when the wide flats of mud deposited by the tides of the Bay of Fundy, are dyked in from the sea, they soon become covered with grasses and carices, the seeds of which are supposed to be washed down by streams and mingled with the marine silt; and fragments of grasses abound in the post-tertiary clays of the Ottawa.

It seems almost ridiculous thus to connect the persistence of the form of a little plant with the subsidence and elevation of whole continents, and the lapse of enormous periods of time. Yet the power which preserves unchanged from generation to generation the humblest animal or plant, is the same with that which causes the permanence of the great laws of physical nature, and the continued revolutions of the earth and all its companion spheres. A little leaf entombed ages on ages ago in the Post-pliocene clays of Canada, preserves in all its minutest features the precise type of that of the same species as it now lives, after all the prodigious geological changes that have intervened. An arctic and alpine plant that has survived all these changes, maintains in its now isolated and far removed stations, all its specific characters unchanged. The flora of a mountain top is precisely what it must have been when it was an island in the glacial seas. These facts relate not to hard crystalline rocks that remain unaltered from age to age, but to little delicate organisms that have many thousands of times died and been renewed in the lapse of time. They show us that what we call a species represents a decision of the unchanging creative will, and that the group of qualities which constitutes our idea of the species, goes on from generation to generation animating new organisms constructed out of different particles of matter. The individual dies but the species lives, and will live until the Power that has decreed its creation shall have decreed its extinction; or until in the slow process of physical change depending on another section of His laws, it shall have been excluded from the possibility of existence anywhere on the surface of the earth.

While the huge ribs of mother earth that project into mountain summits, and the grand and majestic movement of the creative processes by which they have been formed, speak to us of

the majesty of Him to whom the sea belongs, and whose hand formed the dry land, the continuance of these little plants preaches the same lessons of humble faith in the divine promises and laws, which our Lord drew from the lilies of the field.

It is suggestive in connection with the antiquity and migrations of these plants, to consider the differences in this respect of some closely allied species of the same genera. Of the blueberries that grow on the White Mountains, one species, *Vaccinium uliginosum*, is found at Behring's Straits and in northern Europe. *V. cæspitosum* has a wide northern range in America, but is not European. *V. Pennsylvanicum* and *V. Canadense* from their geographical distribution do not seem to belong to the arctic flora at all, but to be of more southern origin. The two bearberries (*Arctostaphylos uva-ursi* and *alpina*), occur together on the White Hills, and on the Scottish and Scandinavian mountains, but the former is a plant of much wider and more southern distribution in America than the latter. Two of the dwarf willows of the White Mountains (*Salix repens* and *S. herbacea*), are European as well as American, but *S. uva-ursi* seems to be confined to America. *Rubus triflorus*, the dwarf raspberry, and *R. Chamæmorus*, the cloud-berry, climb about equally high on Mount Washington, but the former is exclusively American and ranges pretty far southward, while the latter extends no farther south than the northern coast of Maine, and is distributed all around the arctic regions of the Old and New Worlds. It is to be observed, however, that the former can thrive on rich and calcareous soils, while the latter loves those that are barren and granitic; but it is nevetheless probable that *R. triflorus* belongs to a later and more local flora. Similar reasons would induce the belief that the American dwarf cornel or pigeon-berry, (*Cornus Canadensis*), whose distribution is solely American and not properly arctic, is of later origin than the *C. Suecica*, which occurs in northern America locally, and is extensively distributed in northern Europe.

I can but glance at such points as these; but they raise great questions which are to be worked out, not merely by the patient collection of facts, but by a style of scientific thought very much above those which on the one hand escape such problems by the supposition of multiplied centres of creation, or on the other, render their solution worthless by confounding races due to external disturbing causes with species originally distinct. Diffi-

culties of various kinds are easily evaded by either of these extreme views; but with the fact before him of specific diversity and its manifestly long continuance on the one hand, and the remarkable migrations of some species on the other, the true naturalist must be content to work out the problems presented to him with the data afforded by the actual observation of nature, following carefully the threads of guidance thus indicated, not rudely breaking them by too hasty generalisations.

ARTICLE VII.—*On the failure of the Apple Tree in the neighbourhood of Montreal.*—A communication to the Committee of the Natural History Society of Montreal. By John Archbold.

The failure of the apple trees in the neighbourhood of Montreal, and I believe in all the Island, is a sad calamity as regards domestic luxury, as well as in a commercial point of view. I have seen Montreal, in its palmy days of apple-growing, export its thousands of barrels of Pommes Grises, Bourassas, and Fameuses. These were the principal sorts sent to Europe, the refuse of which, as well as the great quantities of wild apples, that is apples from seedlings, always found a ready market at Quebec and the ports below it, at remunerative prices. With these facts clearly before us, it is not to be wondered at that strict enquiry should be made by all who feel the least interest in the culture of the apple, as to the cause of its decay. I have been a resident in Montreal since 1832, and for the last twenty-five years have lived on the south-eastern slope of the Mountain, on the Cote St. Antoine road, and have acted in the capacity of gardener at Mount Pleasant, the then residence of the late Joseph Savage, Esq.; also at Rosemount, the residence of the Hon. John Young, and subsequently at Forden, the residence of Capt. R. T. Raynes, and of the late Charles Bowman, Esq.; one of the most zealous friends and supporters of Horticulture, in his day, that Montreal could boast of. All these places were noted for the production of fine varieties of the apple, the pear, and the plum. The latter place, Forden, in particular, used to yield about fifteen years ago, from 1000 to 1500 lbs. of fruit, but the last three years have made sad havoc with the trees, and unless some reaction in the growth takes place, there will not be one of the old trees living three years hence. I noticed the decline of some sorts of the apple

twenty years ago. I had a talk with the late Henry Corse, Esq., about that time, on the failure of the Early Harvest apple, and he was under the impression that it was then extinct about Montreal, but I convinced him that it was not, for in each of the above mentioned places, I had seen trees of the Early Harvest which gave from three to four barrels of good apples, but these few trees are, I have every reason to believe, now gone. There were also the Ribston Pippin, (much on the decline these last ten years,) the Keswick Codlin, Hawthornden, Grant's Major, John Richardson ; but these and some others, I always looked upon as being tender, from the softness of their wood, which is not nearly so hard as that of the Bourassa, Pomme Grise, and Fameuse, and therefore do not wonder at their destruction. These latter sorts have, however, for the last ten years, been declining in the vigour of their growth, and the size of their fruit. I was for some time under the impression from what I could learn from some gardeners, and other cultivators of fruit, that the above named three sorts of apples, would not bear fruit in any other locality than in the Island of Montreal, but that impression was completely removed, by visiting the Provincial Exhibition held at Brantford, C. W., some years ago. I saw there as fine specimens of the Bourassa, as Montreal could produce in its best days. At Hamilton I also visited some of the gardens, and there to my surprise, I found the Pomme Grise, Fameuse, and Ribston Pippin, growing side by side, and loaded with fine fruit, with not the slightest appearance of decay. These remarks, however, are by the way ; the point of discussion, at present, is the cause of the decay in the apple trees in the vicinity of Montreal. There will no doubt be a great many opinions put forth on the subject, and some light will I hope be thus thrown on both the cause and the cure. Were the decay confined to one place, one kind of soil, or one mode of pruning or culture, there would be less difficulty in discovering both the cause and cure ; but when we find the decay, in one fell swoop, taking off the whole of the young orchards that have been planted within these fifteen or twenty years past, and that even the old *savage*, as the Canadians call it, that has stood the severity of the winters for the last fifty years, is suffering the same fate, the difficulty of giving an opinion is all the greater. When also it is observed that apple trees both in the most sheltered nooks and on the bleakest exposures, on the best alluvial soil, and on the gravelly and limestone rock, all alike share the

same fate, the necessity of careful consideration is much increased. I noticed in several of the apple trees, after the severity of the winter three years ago, that many of the large limbs became disordered by their cellular tissues not admitting that uniform and free flow of sap to the outer extremities of the branches, which was necessary for healthy growth. The consequence was, that there remained in the trunk an overflow of sap, and some very severe freezing nights coming at the time, the sap froze, and caused the outer bark to burst; the trunk soon after presenting a black and decaying appearance. This is one of the causes to which I attribute the decay.

I have also observed in gardens and orchards, at a season when the trees are in full vigour of flower and foliage, that they have been completely denuded of their leaves by the ravages of the caterpillar. Thus being left bare to the influence of a June sun, their health and vigour were seriously impaired. I have observed that trees which suffered so, for two years in succession, hardly ever recovered from the effects of it; this is one other cause to which I attribute the decay of the apple. To avoid injury to the trees, care should be taken as to the time of pruning. When this is done in the beginning of March, or, as is sometimes the case, before that time, and wounds are left bare, without any cover or protection, the influence of a hot sun by day, and hard frost by night, is such, that these wounds emit a portion of the sap, and cause the parts affected to become black, a sure forerunner of decay. In my humble opinion, that work should be deferred till later in the season. My reason for forming this opinion is, that I have observed in my practice of budding, which commences about the middle of July for stone fruits, and continues all through August for the pear and the apple; that having to cut and prune the stocks to a considerable extent, I always found the wounds, at that season, to heal up very quickly, and leave no trace of black, such as might be seen in early spring pruning. Another cause of decay, seems to me to be some kind of atmospheric agency, for I have frequently noticed a portion of the branches of apple trees becoming black in parts where there were no wounds. Sometimes at the junction of the lateral branches with the main branch, and sometimes near the outer extremity of the branch. Some persons attribute the appearance to lightning, but that appears to me rather doubtful, for although thunder and lightning are common in the summer months, in Canada, I never

noticed any parts of apple trees to be blackened to the extent they now are, until these last four years past. There might, indeed, occasionally have been symptoms of decay in some trees, and in certain localities, but the cause in such cases was easily accounted for. This commonly occurred when trees were planted in hard blue sub-soil, saturated with water at all seasons of the year, without the least attention being paid to drainage. On consulting any of the British authors who have written on the culture of the apple, they will all be found to agree that the soil should undergo a thorough preparation, previous to planting, and that it should be trenched at least to the depth of two feet. If such preparation is an essential in such a mild climate as Great Britain, it is much more so in Canada, where we have frequently such a long continuance of drought in the summer, and severe frost in the winter. I have often been struck with the short life of the apple trees about Montreal. There was an impression made on my mind, in early life, that the apple was a long lived tree. I have known apple trees in the west of Ireland, in the neighborhood of the town of Sligo, to attain the age of 150 years, and then to be bearing good crops of apples. I also find that A. J. Downing, one of the most reliable and best American authors, in writing on the age of the apple, says he saw in Rhode Island, two trees 130 years old. He however reckons our fine garden sorts to live only from 50 to 80 years. Now, I question if we could find about Montreal, any of our fine garden sorts half that age, that is 40 years old. He also strongly recommends trenching the soil, and says it adds greatly to the long life of the trees. I must confess that I have not seen that proper attention paid to fruit trees in the neighborhood of Montreal which they require. I have seen, in many cases, trees planted on the green sward, without any other preparation than simply making a hole and putting in the tree; leaving it afterwards to take care of itself. In such cases the result may be easily conjectured. In taking up numbers of both pear and apple trees, the heads of which were dead, I have found that their roots were generally perfectly sound, not showing the least symptom of decay below the surface. The cause of decay does not therefore lie with the root.

The question often occurs to me, shall we ever see Montreal producing the fine fruits that it did twenty-five years ago? The markets were then filled to overflowing with the finest varieties of the plum and the pear, and a pretty good quantity of the peach

and apricot, of open wall culture. Now there is no such thing to be found as a good Bon-chretien pear, or an Autumn Bergamot, or a Burmese Spruce, or yet a luscious Bolman's Washington plum, or a Greengage, or even a coarse Magnum Bonum; and but seldom will you find a good basket of the common wild red plum of the country. I have also noticed a decline in the vigour and growth of several other plants, these last few years past, in comparison with what might have been seen twenty years ago. Then I saw the gardens about Montreal produce enormous crops of melons, with very little care or attention; now it is uncertain if you get a good crop with all the care you can give them. I have also seen good crops of grapes raised in the gardens, and have myself raised at Mount Pleasant, good crops of the Sweet Water and Black Cluster in good condition, in the open ground. Then there was no such thing as the mildew, or the nip, as it is now; nor was that troublesome pest, the curculio, known about Montreal. Yet with all these facts before us, it will not do to be idle lookers on; better to be up and doing. I would suggest that any man possessed of land, whether little or much, should plant trees according to his means, and let what is planted, be planted in the best possible way, and under the best conditions of soil and culture. He may then hope for good results in time to come.

These few remarks, hastily penned, are respectfully submitted to the Montreal Natural History Society.

Forden, 6th January, 1862.

ARTICLE VIII.—*On an Erect Sigillaria and a Carpolite from Nova Scotia.* By J. W. DAWSON, LL.D., F.G.S.

(*From the Journal of the Geological Society of London.*)

The erect trees so frequent in the Joggins coast-section, though often distinctly ribbed, rarely show the minute markings of the leaf-scars in a sufficiently perfect state to enable them to be compared with those of the flattened trunks seen in the shales and ironstones. This, no doubt, arises in part from the circumstance that the bases of the trunks of *Sigillariæ* did not always retain their characteristic markings, and in part from the unfavourable influence of an erect position in coarse and often laminated sediment. The specimen, to which this note relates, and which I obtained in 1859 from a sandstone in Group XIV. of my section of the South Joggins*, affords an exception to the generally

* Quart. Journ. Geol. Soc. vol. x. r. 6.

imperfect condition of these trunks sufficiently remarkable to merit a short notice.

The specimen measures 3 feet in height, and is 10¼ inches in diameter at the base, 9 inches in the middle, and 7½ inches at the top, where it was abruptly broken off. (Fig. 1.) At the base it shows the usual tendency to divide into four main roots; but these have been nipped off or flattened by pressure, not having been filled with sediment. The trunk retains its form on one side, but on the other the bark has been rent from top to bottom, and in part folded inward. This seems to have been caused by the pressure

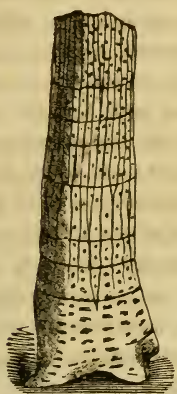

Fig. 1.

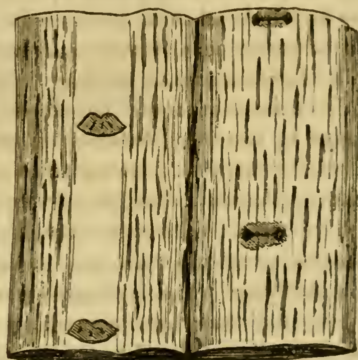

Fig. 2.

of the surrounding sediment, and has probably somewhat diminished the diameter of the stem. The interior of the trunk is filled with grey sandstone, similar to that of the enclosing bed. The outer bark, less than a line in thickness, is in the state of bituminous coal; and an internal cast with a thin coaly envelope represents the pith. This internal cast extends through the greater part of the length, but has fallen to one side. It is only half an inch in diameter. The coaly matter remaining on its surface shows, when prepared with nitric acid, cellular structure; and traces of transverse Sternbergian markings remain in parts of it, so that it must not be regarded as the *woody axis*, which has disappeared, but merely as the *pith-cylinder*.

The leaf-scars and other surface markings are preserved throughout the specimen, but only in a few places in sufficient perfection to show the more minute features of the former. At the upper

part the ribs are very prominent, and there are twenty-six in the whole circumference, the breadth of each rib being about nine-tenths of an inch. On the outer or cortical surface each rib is flattened, or even concave, along the middle, and strongly rounded at the sides, descending into deep intercostal furrows; the flat mesial portion being smooth, the lateral portions marked with sharp vertical ridges, and in places with very delicate longitudinal and transverse striæ. The leaf-scars extend across the smooth middle portion of the rib, and are distant from each other one inch vertically. In form they resemble those of *Sigillaria transversalis*, *S. Defrancii*, and *S. Brochantii*, Brongt., being transversely lanceolate, emarginate above, with acute lateral edges. Those best diplayed show two vascular punctures, with a third mark or prominence between and rather below them. On the so-called ligneous surface, or that of the inner bark, the ribs are slightly furrowed or striated lengthwise; and the leaf-scars are represented by two deep punctures of the vascular scars. (Fig. 2.)

In tracing the ribs downward, some of them wedge out and disappear: so that at the middle of the length of the trunk there may be about 22; each with a breadth increased to one inch and four-tenths, and flatter than those at the top, with the intercostal furrow shallower. The leaf-scars are now widened transversely, and have lost their minute markings on the cortical surface; while on the ligneous surface the vascular punctures are twice as far apart as at the top. About the middle the vertical distance of the scars diminishes somewhat suddenly to seven-tenths of an inch.

In the lower third of the stem the ribs are quite obliterated, and the whole surface is wrinkled with coarse waving striæ or small furrows, due apparently to the expansion of the outer bark. The leaf-scars still remain in regular vertical rows; but these are reduced to about twelve, and apparently at the base to as few as nine. The vertical distance of the scars is still about 0·7 inch; but the transverse distance between the centres of the rows is increased to 2·8 inches or more. In form the leaf-scars are now transverse furrows, an inch or more in length, and the vascular punctures are half an inch or more apart in each scar. *A single row* of these wider scars is shown in (Fig. 3.)

Of the roots I could obtain no specimens; but the markings on the bark at the base of the trunk are precisely similar to those on many Stigmarian roots found attached to less perfectly preserved

stems, and a few stigmaroid areoles are perceptible on the lower surface of the stump.

The woody axis has entirely disappeard, nor does any mineral charcoal appear in the base of the cast. It has either been en-

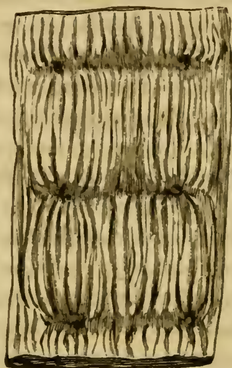

Fig. 3.

tirely removed by decay, or has been washed out by the waves before the hollow bark was filled up.

As this trunk appears to belong to a species not previously described, and we have a better knowledge of its parts and mode of growth than of those of most of the named species, I may propose for it a specific appellation, and would call it *Sigillaria Brownii*, in commemoration of the many interesting discoveries in relation to these plants made by my friend Richard Brown, Esq., of Sydney, Cape Breton.

The following are the most important points relating to *Sigillariæ* in general, illustrated by the specimen above-described:—1. The evidence of the exogenous growth of *Sigillaria.* The growth of the trunk took place, as I have elsewhere maintained,* by the introduction of new woody wedges in the axis and by additions to the surface of the axis and to the inner bark, after the manner of exogenous stems. When the present trunk had nine rows of scars it was only three inches in diameter, perhaps much less, and as it grew in height the base expanded in such a manner as to increase the distances between the scars and the distances between the vascular punctures in the scars, while new rows of leaves were added above until the number amounted to about 26. The same appearances in a species quite distinct from the present

* Quart. Journ. Geol. Soc. vol. x. p. 32.

are illustrated in my paper on the South Joggins section. Specimens which I have observed, however, as well as facts stated by Mr. Brown and by Brongniart, induce me to believe that in some species this mode of growth was so far modified that new ribs were introduced to the very base of the trunk. The expansion of the trunk was accompanied by the flattening out of the ribs, and also by the giving way of the thin outer bark, the inner or middle bark evidently remaining in a growing state to the base of the stem. 2. The decadence of the leaves from the lower part of the trunk in the living state, is proved by the condition of the scars. We may also note the shorter vertical distance of the scars on the lower part of the trunk, showing that, when young, the leaves were much more crowded than subsequently: and the absence of bands of deformed and crowded scars sometimes seen on *Sigillariæ**, probably connected with periods of fructification, and possibly occurring on the upper part of the trunk only. 3. The difficulty of comparing the characters of erect with those of prostrate *Sigillariæ;* the former usually showing only the base of the stem, the latter often only the upper part, and these differing so materially that they may be mistaken for distinct species. 4. The mode of growth illustrated by the specimen may apply only to a portion of the plants usually included in the genus. The species of *Sigillaria* found at the Joggins may amount to about twenty; and with reference merely to the habit of growth, without regard to the resemblances or differences in the leaf-scars, these may be arranged in three groups. The first will include the present species with *S. reniformis*, *S. alternans*, *S. organum*, and another (*S. ovalis*, mihi) with oval scars like those of *S. catenulata* but an inch apart vertically. These have broad and well-marked ribs, attain to a large size, and often occur erect. Other species with narrow and less distinct ribs and more or less crowded scars, as *S. elegans*, *S. Knorrii*, *S. scutellata*, *S. Saullii*, &c., do not appear to have attained to so great diameter, and are more rarely seen erect. In some of these species the markings and leaf-scars seem to be more perfectly preserved to the very base of the trunk than in the species before mentioned. A third group consists of species like *S. Defrancii*, *S. Menardii*, &c., which are destitute of ribs and have the scars arranged spirally. Some of these were of considerable diameter, others quite small; but they are rare, and I have not recognized them in the erect position.

* Ibid. vol. xv. p. 640.

5. In connection with the absence of the usual remains of wood as mineral charcoal from this trunk, it may be stated that the bast-like tissue of the inner bark of *Sigillariæ* is abundant in some of the coal of the Joggins; whilst the discigerous tissue* is prevalent in the great Pictou coal-seam. In the former case the decomposition of the vegetable matter was probably subaërial, or like that of a forest-soil; whilst the conditions of the latter were those of peaty bogs.

CARPOLITE *from the* COAL-FORMATION *of* CAPE BRETON.

ALL the best authorities on coal-plants are disposed to refer the seeds or fruits known by the generic names *Trigonocarpum* and *Rhabdocarpus* to phænogams, and probably to gymnosperms. In this case they may have belonged to *Coniferæ* or *Sigillariæ*, or to both. That they belonged in great part to the latter is, I think, rendered probable by their occurrence very abundantly in the middle part of the coal-measures where *Sigillariæ* abound, by their various forms corresponding rather to the many species of *Sigillariæ* than to the few of Conifers, and by their abundant occurrence in the interior of hollow stumps of *Sigillariæ* and in the surrounding beds. Still these fruits or seeds may have belonged to very different plants; and as an example of the type of structure most frequently associated with *Sigillariæ*, I have prepared a short notice of a species of which very well-preserved specimens exist in my collection, and to which I have assigned the name of

TRIGONOCARPUM HOOKERI.

Numerous specimens of this species occur in a thin calcareous layer in the coal-measures near Port Hood, Cape Breton. They are not compressed, and are fossilized by calc-spar and iron-pyrites. Their form is ovate,—the length being 0·3 inch, and the breadth 0·2 inch. The external surface is rough and destitute of distinct markings. Internally they present the following structures:—1. An outer coat (*testa*), which is thick, carbonaceous, and apparently of a dense cellular structure. This corresponds to the outer supposed "fleshy coat" of Lindley and Hooker; but in this species I think it must have been firm and hard, like the outer coat of the seeds of pines, which it much resembles in appearance and structure. 2. An inner coat (*tegmen* or *embryo-sac*)

* Ibid. vol. xii. p. 631.

which is thin and marked on its outer surface with interrupted ridges, almost precisely in the manner of the corresponding coat in the seed of *Pinus pinea*. This coat is often pyritised, and in

Figs. 1 to 5.—Trigonocarpum Hookeri, *Dawson ; from the Coal-measures of Cape Breton.*

Fig. 1.

Fig. 2.

Fig. 3.

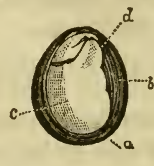

Fig. 5.

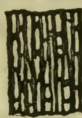

Fig. 4.

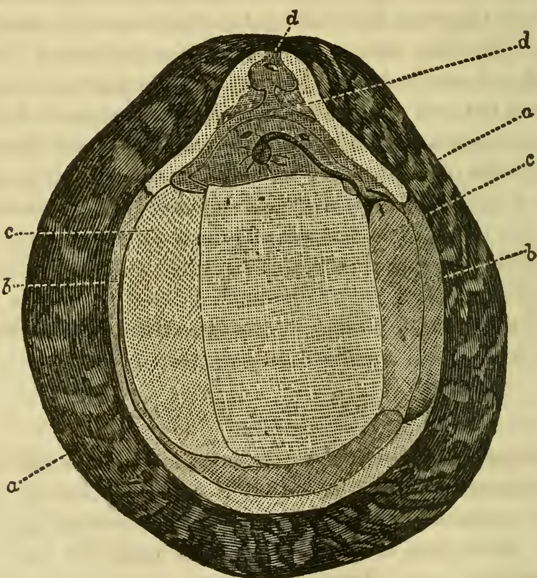

Fig. 1. Perfect specimen, natural size.
Fig. 2. Specimen deprived of its outer coating.
Fig. 3. Broken specimen magnified.
Fig. 4. Section magnified : *a*, the testa ; *b*, the tegmen ; *c*, the nucleus, and *d*, the embryo.
Fig. 5. Portion of the surface of the inner coat more highly magnified.

some specimens it presents toward the smaller end indications of three ridges. It corresponds, no doubt, to the outer coat of the ordinary *Trigonocarpa*. 3. A nucleus occupying the whole in-

terior of the last-mentioned coat, and exhibiting at the smaller end certain wrinkles and a projecting tubercle, marking the position of the embryo and micropyle. When the seed is sliced longitudinally, the nucleus is seen to present an outer thick layer of calcspar, stained by vegetable matter, and an inner mass which is colourless. In the smaller end, toward the micropyle, the remains of the embryo and its suspensor are seen replaced by iron-pyrites, in the manner represented in fig. 3. In some specimens the outer coat appears as if divided into two layers, and the nucleus has shrunk inwards from the inner coat, presenting two additional surfaces, which may represent original lines of structure, but are perhaps, results of decay.

A very similar species, which occurs in vast abundance in the interior of an erect *Sigillaria* at the Joggins, has the outer coating very dense and coaly, and with a transverse fibrous structure. In some specimens it shows a projecting ridge on each side, and longitudinal striæ, which might entitle it to be placed in the genus *Rhabdocarpus;* but no coal-fossils are more deceptive than these carpolites, which, when flattened or deprived of their outer coats, present appearances very dissimilar from those of the perfect condition.

I am by no means certain that this note adds much to the knowledge already possessed of the structure of *Trigonocarpum;* but it affords an additional example, and this of a species similar to those most frequently associated with remains of *Sigillariæ.*

ARTICLE IX.—*On the Primitive Formations in Norway and in Canada, and their Mineral Wealth.* By THOMAS MACFARLANE.

(*Continued from page* 20.)

II. THE PRIMITIVE SLATE FORMATION.

A: *The Quartzose Group.*

The district in which the above-named group of rocks is principally developed is that of Tellemarken, in the south of Norway, celebrated by tourists as containing perhaps the most wild and picturesque scenery in the north of Europe. There exist also northward from Trondhjem, some districts, where the same group seems to prevail, but these cannot be compared with that of Tellemarken, either in extent or economic importance; nor have

they been studied or described so minutely.* Naumann entitled this district, the Nummedal and Tellemarken Quartz Formation; Keilhau described it as the Goustafjeld Region, from the mountain which is its most distinguished topographical feature; while Dahll somewhat indefinitely calls it the Tellemarken Slate Formation.

The rocks which constitute this group are the following:

1. *Quartzite or quartz slate.* This, the most widely distributed rock of the group, occurs in the most multifarious varieties. Pure quartz, with a granular structure and glassy lustre, of considerable transparency, and of a white or greyish-white colour, is to be found in beds of great thickness. Fine-grained quartz, with a fatty lustre, and rose-red or flesh-red in color. is also observed in equally powerful beds. The most common varieties are however the splintery, grey, and slightly micaceous quartzites, which are known as quartz slates. Amongst the more impure varieties, talcose, feldspathic, and hornblendic quartzites are to be distinguished.

2. *Mica schist*, differing considerably in general character from that which occurs in the Primitive Gneiss Formation. The broad-leaved very micaceous variety, with garnets, which is common in that formation, has not been observed at all in this quartzose series. In the constitution of the mica schist belonging to the latter, quartz greatly preponderates, and the rock differs from quartz slate, only in containing a somewhat larger quantity of silver-white or brownish-black mica.

3. *Gneiss* may be also said to occur in this group, but of a character widely different from what is usually understood by this term. It is finer grained and less slaty than the characteristic primitive gneiss, while the feldspar and quartz, and especially the latter, greatly preponderate in quantity over the mica. This latter mineral, which plays such an important part in the composition of ordinary gneiss, is very little developed, and hornblende is never found replacing it; so that nothing resembling hornblendic gneiss is found in this group.

4. *Hornstone and hornstone porphyry*, passing into jasper, often occur, and seem to consist of the same minerals, and in the same proportions, as the two last named rocks, but so fine grained that the species are no longer recognizable. The mica schist is seen

* According to Keilhau, the district in West Finmark and Quænanger, in which the Alten Copper Mines occur, belongs to this group. It is probable also, that another district to the east of the North Cape is of the same formation.

in some places to pass into a grey, coarse, splintery, quartzose hornstone; while the gneiss gives a red or brown hornstone, with fine splintery, and nearly smooth fractures.

5. *Hornblende slate.*

6. *Talc slate.*

7. *Chlorite slate.*

8. *Clay slate.*

9. *Limestone* has only been remarked at one place in the whole group, where a thin bed of granular yellowish-white limestone, occurs in the quartzose gneiss.

10. *Greenstone and diorite*, composed principally of albite and hornblende, occur in large and important masses.

11. *Granite* does not seem to occur interstratified with the members of this group, but frequently intersects them in the form of veins, and also forms irregular masses.

12. *Conglomerates and breccias* occur in such quantity, and of such peculiar characters, as to constitute a distinguishing feature of the formation. The whole of the rocks already named as forming part of this group, but especially the quartzites, often contain beds or irregular masses, having the aspect of conglomerates; which are made up of fragments of the respectively enclosing rocks, cemented together either by a micaceous or talcose substance. The fragments are more or less rounded, and often of oblong forms; they generally lie parallel with each other, but very often bear little resemblance to boulders.

The rocks just enumerated, form layers, often of enormous thickness,which alternate with each other, forming parallel groups, in which one or the other of them (generally the quartz), predominates. The fine and coarse grained greenstones or diorites of the formation, are most generally in layers running parallel with the other rocks. They sometimes however occur as veins cutting these, and more frequently as irregular masses. The greenstone beds are often of great extent, and pass through gradual transitions into the neighboring rocks. A layer of diorite occurs in the parish of Skafse, having a thickness of 1000 feet. In the middle it is granular, but towards each side, it gradually assumes a slaty texture. It has also been remarked of other greenstone layers in the group, that they assume a slaty structure, as they approach the rocks above or below them. Keilhau has the following remarks with regard to the extent which these greenstone or diorite rocks occupy in the series before us. " We may obtain a good

idea of the extent to which this member of the group is developed, from the district west of Bandag Lake. On the road to Mo church, we are surrounded by rugged mountains about 2500 feet high, and these from the bottom of the valley to their summits, consist of the same mass of diorite, which has here a breadth of about two geographical miles."

The conglomerates, of which mention has already been made, have such an important bearing on the question of the origin of the primitive slate formation, that I may be excused for inserting here, at length, a translation of Keilhau's description of them. These conglomerates have been observed: 1. above Hjærdal church ; 2. on the road from Fladdal to Manddal ; and, 3. on the road from Guldnæs to Berge, in Morgedal. " The first locality in which the conglomerate quartzites occur in repeated alternations with hornblende rock (diorite), has been described by Naumann (Beitrage I, 79). The quartz layers there consist of what often appears to be a very fine-grained micaceous sandstone; in which harder round or oval concretions, sometimes feldspathic, sometimes quartzose, and sometimes of still more varied natures, are imbedded. The softer cementing matter is frequently worn away, so that the harder masses stand out from the rock, like hemispheres. The smaller and more varied in their nature these concretions (which appear formed exactly like boulders) are, the more talcose the enclosing mass becomes; whereby the slaty texture of the quarzite becomes undulating and confused."

The second of the above mentioned localities is on the Mandœla, a short distance before it falls into the Sillegjord. The bluish-grey, very pure and crystalline quartzite which here occurs, is for a considerable distance around, apparently unstratified, and cannot strictly be defined as quartz-slate. It forms powerful masses, in the midst of which large and indistinctly limited portions, are more or less thickly impregnated with small rounded portions of quartz of the most different shades of color, from white to red and dark-grey. Some of these are quartz, others jasper, while others resemble hornstone; but all of them, even those which most closely resemble their quartzose matrix, are sharply defined, and appear like pebbles cemented into it. The fact that these portions are not arranged as separate layers, but spread out as irregular areas, in the massive and crystalline quartz, is to be regarded as unfavorable to the opinion of the mechanical origin of these conglomerates." " At the third of the

above mentioned localities, the conglomerate is also enveloped in a large group of quartzite, which contains besides, only a few isolated masses of greenstone. The perfectly boulder-like concretions of the conglomerate bed, which range from the size of a hazelnut, to that of the human head, are here of the same sort of greyish-white splintery quartz, which forms the strata of the whole surrounding group. A few of them only are reddish, and remind one of the jasper-like masses which appear to be generally associated with these conglomerate quartzites. At the Hjærdal locality, already described, Naumann found whole layers of jasper, close to the conglomerate. The cementing material of the conglomerate betwixt Guldnæs and Berge is argillaceous, and small in amount; and is certainly to be regarded as analogous to the small beds of clay slate, which occur as regular layers between the thick quartz strata, at other points in this neighborhood. Although the foliation of the pure quartzite is retained in the conglomerate, which is many fathoms thick, this nevertheless, like that below Manddal, does not appear to occupy any well-defined horizon in the stratification. In place of forming a continuous zone along the strike, it appears rather to be a comparatively short and irregular mass.

Occurrences of this sort, which may be regarded as belonging at once to the quartz and to the mica schist, are found to a considerable extent on the northwest of Sillegjord Lake. Here, on the boundary of the primitive gneiss formation, at several points where the quartzite begins to replace the mica-schist, we find layers in which the quartz occurs in the shape of long cylinders as thick as the finger, and rounded off at both ends, as elongated almond-shaped masses; or in the form of boulders, imbedded in a cement of mica schist.

Some time since, Naumann directed attention to the fact that the amount of talc contained in the cement is greater, the more the conglomerate is varied in its composition. I have often confirmed this, and have moreover remarked that the talc seems to stand in some intimate connection with these problematical rocks. This may be the reason why they have nowhere been found more frequently than on the road between Berge in Brunkeberg, and Qvale in Höidalsmo ; where the quartz beds are associated with other rocks, and especially with those of a talcose nature. The most remarkable conglomerate of this district, as well on account of its composition, as its thickness, is splendidly exposed in a narrow

ravine called Ormebrækjuvet, which cuts across the conglomerate, inclined at an angle of 70°. A road and a rivulet here pass through the ravine, and the rocks are seen in profile on both sides. In a coarse mass of quartzose talc-slate, sometimes more or less micaceous or argillaceous, different varieties of quartz are imbedded; which have the form of small boulders, or are elongated in the direction of the stratification. Besides these, there may be remarked in the slate, a multitude of red and very fine-grained feldspathic concretions, which betray here and there a gneissoid nature, caused by dark mica-like streaks. These feldspathic concretions are the more remarkable, since hitherto, no rock far or near,has been discovered bearing the slightest resemblance to them, although their oval form, in some parts, and the fact that they are sometimes bent in the direction of the undulations of the surrounding mass of slate, would favor the view that they are pebbles from an older rock. They become still more remarkable when we observe them repeated at very distant points. Exactly similar gneissoid concretions with those of Tellemarken, of which we here speak, have been remarked in the conglomerate rocks of North Trondhjems Amt. The boulder-like fragments in the rock of Ormebrækjuvet, attain the size of a closed fist, and lie usually so near to each other, that they constitute the greater part of the whole rock. Eastward from Holvig, towards Vaæ, down in Vestfjorddalen, conglomerate talcose rocks also are found. Here, in a talcose slate, a layer was observed including larger and smaller kernels of quartz, sometimes almond-shaped, at other times more irregular; and one part, apparently segregations from the slate itself. The foliated portions of the rock are bent and rolled around these masses. On the weathered surfaces of the rock, these irregular, and, as it were, imbedded portions, have a lighter color than the surrounding mass. There is probably some feldspar present in these, as well as in the gneissoid concretions already mentioned, and their lighter colour may be due to kaolin from its decomposition. Southward from Holvig, a layer of similar rock occurs, which belongs to the clay slate."

"Conglomerates which belong to the chloritic rocks in this district, are found at various places in the upper part of Vestfjorddalen, in the neighborhood of the cataract Rjukanfoss. From Vaæ, over and beyond Maristigen, a hard chloritic slate predominates; which appears often as if it had been torn in pieces, and then joined together again, and which contains other very

curious aggregations. There may be observed masses like serpentine, portions of greenstone, &c., combined in the most varied manner with the slate; while many phenomena render this place suitable for a more minute study of these conglomerates."

"Farther on, at several points in the neighbourhood of Aamdal, it may be observed that the mica schist contains concretions having the appearance of imbedded fragments, and with an aspect, from which one must believe that it has once been broken up, and its pieces afterwards irregularly joined together. For example, there is exposed between Aamdal Copper-work and Skafse church, a large area of this character. The rock is a fine slaty quartzose mica schist, which, as if by an internal breaking-up, has acquired a well marked brecciated structure. Only a few of the recemented pieces have rounded angles, the most of them being sharp-cornered. The whole rock, but especially the fragments, contain some feldspar. I will mention one other instance, from which it appears that hornblende schist may also sometimes contain fragments of foreign masses. This is the case on Skafseberg, over which the road leads from Mo to Skafse church. Here the concretions are again feldspathic, and even gneissoid, but most of them resemble rather the rudiments of small bent layers or beds, than fragments cemented into the hornblende schist."*

As before remarked, the quartzites or rocks allied to them, such as the quartzose mica schists and gneiss, constitute by far the greatest portion of the group. Next in frequency and extent, the greenstones or diorites may be placed; after these the hornblende, talc, and chlorite schists, and the clay-slates; and lastly, the conglomerates.

Foldings of the strata in the quartzose group, have been observed in various places, but they do not approach, in intricacy, to the contortions of the gneiss formation. The strata are seldom found horizontal, and generally have a dip of more than 45°; although they do not seem, generally, to be so near to the vertical as those of the gneiss formation. The direction of the strike varies much more than in the latter, but parallel groups have been traced upwards of eight geographical miles, on the strike. In some places, an approach to a regular succession of the rocks has been observed, but the particulars related are by no means conclusive.

As before mentioned, the scenery of this district is of the most

* Geæ Norvegica, I. 430.

wild and rugged nature. The Fjelds, consisting of quartz rock, sometimes present massive peaks, rising in the shape of terraces one above the other; which latter form is caused by the outcrops of the highly inclined quartz beds. Goustafjeld itself, is a huge peak, rising to the height of 7000 feet, and presenting from a distance, a peculiar furrowed appearance, the cause of which is thus explained by Keilhau:—"The upper part of Goustafjeld is formed of two varieties of quartzite, one of which is the preponderating, and the other the subordinate constituent. The former belongs to the purer varieties of the quartzite, and resists decomposition. In the latter, which easily disintegrates to a coarse sand, particles of feldspar are more or less abundantly disseminated. From that part of the mountain where these rocks are found *in situ*, which is about 300 feet perpendicularly beneath the sharp ridge forming the summit, going upwards,there is observable only a succession of very regular beds, having a dip of from 20° to 30°. The mountain is here so sharply peaked, that the beds crop out, as well on the side of the direction of the dip, as on the opposite side. If now the relations of the rocks were as usual, the feldspathic quartzite would be found to form more or less isolated layers, between the strata of the preponderating rock; but in place of this, the feldspathic quartzite extends in an entirely opposite direction through the mass of the prevailing rock. It goes right across the strata, and that without in the least (like veins) interrupting the continuity of the several beds, because these otherwise different rocks, at their junction, run into each other, the pure quartz gradually becoming feldspathic. The consequence of this remarkable relation is very striking. On account of the feldspathic quartzite being so easily disintegrated, and the pure variety, on the other hand, resisting so well, there are produced, where the former crops out, cuts on the ridge, and furrows on the sides of the mountain. On account of the height of the mountain (7000 feet), these furrows remain filled with snow throughout the whole year, and are recognisable from a great distance. Thus Goustafjeld preserves the marked features which distinguish this surprisingly furrowed peak, for those who view it from the heights of Hallingdal or Hadeland."

"It is a characteristic trait of this group, as well as of the other sections of the country, analogous with it in geological character, and worthy a mention at the outset, that it is especially well supplied with copper ores."* This great prevalence of cop-

* Geæ Norvegica I, 441.

per ores has given rise, since the beginning of the 16th century, to the establishment of six different copper works or mining establishments ; all of which however, with but one exception, that of Aamdal, are abandoned. In describing the various mineral deposits, I shall only refer to those of most importance, neglecting altogether the innumerable localities of less value. The mines about to be described are those belonging to the copper works of Guldnæs, Aamdal, Hvideseid, Sauland and Hovindbygden.

The deposit on which the Guldnæs mines occur, is probably the most important of the whole district. It is situated on the southwest side of Sundsbarm Lake, in the parish of Sillegjord, at least 1500 feet above the sea, and inaccessible, unless to the foot traveller. It has the form of a layer, and lies between a bed of quartzite, and one of clay slate. It has a length of about 100 fathoms, and a breadth of about 100 feet, and is composed of a flesh-red and sometimes greenish-white aggregation of quartz, feldspar and talc; in which purple copper and copper pyrites are more or less abundantly disseminated. The ore is found in irregular nests and veins, quartz accompanying it in the latter. These irregular bunches of ore are frequently found in such quantity, as to render the whole mass of the layer worthy of excavation. There is not much of the rock with finely disseminated mineral, and the ore is much more suited for being dressed by means of crushing and jigging, than by stamping and washing. The latter processes were nevertheless those employed when the mines were being worked, and this may partially account for the unsuccessful result. The copper ores occurring here are argentiferous ; the metallic copper resulting from their treatment, containing one per cent. of silver.

The mines belonging to the Aamdal copper works are very numerous ; the most important of them being Hoffnung mine, Næsmark mine and Mosnap mine. The works themselves, are situated 1300 feet above the sea,on the river called Værkselven, in the parish of Skafse ; which is subordinate to that of Mo. Hoffnung mine lies about 150 feet higher, near the junction of a gneissoid granite, of eruptive origin, with the primitive slates. The two lodes containing the ore, occur on both sides of a layer of hornblende schist ; which varies from two to six feet in thickness, and has a fall of from 50° to 60° to the W.N.W. They run parallel with the strata, and the lode underlying the hornblende schist is the most

important. It has a thickness of from four to thirty inches; the vein-stone is quartz, and is well filled with copper pyrites, generally massive, seldom finely disseminated. In the deeper workings, the lode almost contains as much purple copper as copper pyrites, with no admixture of iron pyrites, or other mineral, except a little feld spar. The ore, on being excavated, was crushed by flat-faced hand hammers, brought up, by jigging, to 30 per cent., and then smelted or sold. Næsmark mine is like Hoffnung, situated in the immediate neighborhood of the work, on a granite vein, two fathoms thick, which intersects primitive slates. In this vein, (from which also side veins shoot out into the adjoining slates,) there occur, running in a direction at right angles with its line of strike, numerous lodes of from two to six inches thick, filled with quartz and copper glance; the latter containing six oz. of silver per cwt. The granite in the neighborhood of these quartz veins is also impregnated with copper glance, to such an extent, as to make it amply worth stamping and washing. This mine is a most promising one; is altogether new, and the granitic vein has been discovered at a distance of three miles from it, at Bergland mine; where it bears copper glance in exactly the same manner as at Næsmark. The ore from the quartz lodes of this mine was brought up by hand-jigging to 70 per cent., and then either smelted or sold. The finely divided ore was worked by stamping and washing. Mosnap mine is about 10 miles distant from the work, and probably lies 2000 feet above the sea. The rocks in the neighborhood are the gneiss, mica schist, and hornblende schist, peculiar to the quartzose group. The mine itself is situated on a granitic vein,which contains irregular quartz layers. Copper pyrites, purple copper, and molybdenite are disseminated through it, but are more especially associated with the quartz. The vein itself has a thickness of several feet, and were it more conveniently situated, would doubtless be considered a very valuable deposit. It is only very lately that the ores from these mines began to be treated by crushing and jigging, and then sent to market. They were previously stamped and washed, at least the poorer sorts, and the products were smelted at the works, along with the richer ores. The smelting, however, even after the discovery of a vein of fluor spar, which was used as flux, was carried on but with indifferent success, on account of the highly quartzose natures of the ores. After the introduction of jigging, the ores were treated as follows, at the smelting works:—The copper glance from Næsmark was calcined in a reverberatory

furnace, and the silver extracted according to Ziervogel's method; by treating it with water, and afterwards precipitating the dissolved silver by metallic copper. The lixiviated residue from this process, was then smelted together with the rich copper pyrites and schlichs from the Hoffnung mine, (previously calcined in a reverberatory furnace), in a small shaft furnace. From this operation, there resulted a slag, very rich in ferrous oxide, which was rejected; a regulus with 55 per cent. of copper, aud a small quantity of coarse copper. The regulus was roasted and again smelted; coarse copper, and a small quantity of thin regulus being produced. The coarse copper was then refined on the small German gahr hearth.

The two most important mines belonging to Hvideseid copper-works, occur in the parish of Hvides, and are as follows: Haukum mine, situated beneath Brokefjeld, in the neighborhood of a powerful granite vein, wherein orthoclase and oligoclase are observable. This vein intersects primitive slates, and is accompanied by several irregular granitic masses, on the largest of which the mine occurs. The granite mass is more or less impregnated with purple copper, and this is occasionally accompanied by metallic silver in fine threads; which occur in small cavities, with crystals of laumontite and stilbite. The crystals of laumontite form fan-like groups, which are coloured green by the oxyd of copper A very small scale of gold has been found in this mine. The following minerals are also met with: magnetic iron ore, molybdenite, garnet, epidote, and traces of copper pyrites.* Bandag mine is situated on the precipitous south side of Bandag Lake. The surrounding rock bears a strong resemblance to granitic gneiss, but nevertheless differs from it in having a larger quantity of quartz, and, as a consequence, a lighter colour. The ore deposit lies parallel with the stratification of this rock, and consists of a granular mixture of quartz, mica, copper pyrites, purple copper, highly argentiferous galena, zinc blende, and a little feldspar. Metallic silver in threads, has also been remarked in this mine. The ores from these, and other mines, were for a considerable time smelted at the Hvideseid works, and although the smelting was ultimately abandoned, the operation was more successful here than anywhere else in the district, being carried on for a longer time.

The Sauland smelting works were built for the copper ores occurring at Guli, in the parish of Sauland, which is subordi-

* Dahll, Om Telemarken's Geologie, p. 27.

nate to Hjærdal. The lode, which occurs in a coarse grained diorite, is sometimes of considerable thickness, and consists of quartz well charged with purple copper. Here, too, the smelting was unsuccessful, even more so than elsewhere in the district.

The ore deposits near Horindbygden in the parish of Tin, are described by Keilhau,* and are the following: I. That of Rödsöe consists of a layer of quartz, containing partly massive and partly disseminated copper glance. The thickness is about three feet, the strike north and south, and the dip vertical. It is traceable over a length of 200 feet. II. That of Daarudberge contains also some copper glance in a quartz bed, two feet thick, but appears less rich than that of Rödsöe. III. That of Vashoed is a quartz layer of six inches thick, with a strike north and south, and contains some purple copper. The adjacent rock is full of magnetic iron ore, disseminated, and crystallized in very small octohedrons.

A deposit of iron ore has been described by Dahll,† as occurring in Nissedal, between the farms Aarhuus and Söfdestad. It appears to be a vein, and runs from north to south over the hill called Grubeaasen. It dips 30° to 50° towards east, and has a thickness of nine feet on an average. It is exposed for a distance of 210 fathoms, between two small valleys. In the deepest portion, it consists of magnetic iron ore, but on ascending the hill from both sides, the magnetic ore becomes mixed with iron glance, (specular iron ore); the quantity of which gradually increases, until, at the highest part, iron glance alone is present. The surrounding slates are mica schist, containing a little hornblende, hornblende schist and feldspar, and containing portions having a granular structure. The vein is more distinctly separated from the side rock, where it consists of magnetic ore, than when the iron glance is present. The latter penetrates into the side rock, where it replaces the feldspar. It is thus possible to find hand specimens consisting only of iron glance and hornblende. Quartz and desmine are present in the vein. It is impossible to determine with certainty the age of this deposit, but it is intersected by granite veins.

In concluding this description of the quartzose division of the primitive slate formation, and of its economic minerals, as developed in Norway, I think that the following features may be mentioned as characteristic of the group. I. The preponderance of quartzose rocks; II. The presence of conglomerates of a pecu-

* Geæ Norvegica, p. 442.

† Om Telemarken's Geologie, p. 31.

liar character ; III. The prevalence of copper ores, of a high percentage, unmixed with iron pyrites; the veinstone accompanying them being quartzose, and therefore difficultly fusible; IV. The presence of iron glance in the few deposits of iron ore occurring in the group.

The equivalent of these rocks in Canada appears to be the Huronian formation. In support of this view I shall avail myself of the minute descriptions of the latter to be found in the Reports of the Geological Survey, and particularly in Sir W. E. Logan's Report on the north shore of Lake Huron. The rocks of the Huronian formation are, by these authorities, described as follows:

" The quartzites have sometimes the aspect of sandstones, but at other times lose their granular texture, and become a vitreous quartz. Not unfrequently the quartzite is thin bedded, and even schistose in its structure, and it sometimes holds a little mica, passing into a variety of mica schist.

" These quartzites often become conglomerate, enclosing pebbles of quartz and various coloured jaspers. These pebbles are sometimes arranged in thin layers among fine grained beds. At other times, the conglomerates form thicker beds, which swell into mountain masses; including great portions which contain blood-red jaspers in a white matrix, constituting a very beautiful rock.

" In addition to these, there are conglomerates of a distinctly different character, belonging to this formation. They are composed chiefly of syenitic pebbles, held in a grey argillo-arenaceous cement, which is more frequently of a greenish color, from the presence of chlorite. The pebbles, which are of reddish and grey colors, vary greatly in size, being sometimes no larger than swan shot, and at others, boulders rather than pebbles, measuring upwards of a foot in diameter.

" The quantities in which they are aggregated vary much. They sometimes constitute nearly the whole mass of the rock, leaving but few interstices for a matrix, and sometimes on the contrary, they are so sparingly disseminated through considerable portions, as to leave spaces of several feet between neighboring pebbles; which are still, in such cases, often several inches in diameter. With the syenitic pebbles, are occasionally associated some of different colored jaspers. The matrix appears often to pass on the one hand, into the grey quartz rock, by an increased proportion of the arenaceous particles; and on the other, into a thin bedded greenish fine grained slate, which is

sometimes very chloritic. In a third form, the matrix is scarcely distinguishable from a fine grained greenstone In the slate, the stratification is often marked by slight differences of color, in the direction of which, it is occasionally cleavable. The bands in other instances, are firmly soldered together, but in both cases, joints usually prevail, dividing the rock into rhomboidal forms, which are sometimes very regular."

These slates sometimes approach to argillites, but often, through the chloritic varieties, appear to pass into greenstone or diorite, which, in its typical form, consists of a greenish white feldspar, with dark green or black hornblende. The feldspar is sometimes however, more or less tinged with red, and the rock then occasionally appears to pass into a kind of syenite, by the addition of a very sparing amount of quartz. These two forms of the rock are generally highly crystalline, and not very fine grained. The greenstone, however, sometimes displays a fine texture; and in such cases it frequently holds much disseminated chlorite, giving it a very decided green colour. Portions are found, containing so great a proportion of the mineral, as to yield with facility to the knife.

Associated with these, are three bands of impure limestone, often silicious and sometimes dolomitic, the uppermost one of which, is interstratified with a large amount of hornstone, in very regular beds. The total thickness of the formation on Lake Huron, is estimated about 18,000 feet; of which more than 10,000 feet are quartzites, including the jasper conglomerates. 900 feet of the remainder are limestone and hornstone bands, and the remainder the slate conglomerates, with chloritic and epidotic slates the whole being interstratified with diorites.

While the great mass of these greenstones or diorites, are supposed to be altered sedimentary beds,there are other greenstones, which, as well as certain granites in the formation, are evidently intrusive.

The most important mineral deposits of the Huronian series are the copper lodes at the Bruce, Wellington, and Huron Bay mines. The ores are here yellow and purple sulphuret, in veins, of quartz, which cut the diorites of the region. According to Sir W. E. Logan's careful examination of the Bruce Mines, made in 1848, about 3000 square fathoms of the lodes were computed to contain, on an average, $6\frac{1}{3}$ per cent. of copper. Since then, about 9000 tons of 18 per cent. ore have been raised from the mine, which has been opened to a depth of 50 fathoms. Attempts

were made to smelt the ores, in a furnace erected on the spot, but they are now shipped to Great Britain or to the United States. The adjacent mines appears to be yielding even larger quantities of ore than the Bruce. Copper mining has been attempted also at Root River, at Echo Lake, and in many other localities in this formation; which, like its Norwegian equivalent, appears to be eminently cupriferous. At the Wallace mine on Lake Huron, copper pyrites occurs, with an arsenical sulphuret of nickel, but the deposit has not been much examined. In the same vicinity, Mr. Murray has described a bed of specular iron or red hematitic ore, and he has shown that the immense deposits of this ore now so extensively wrought at Marquette, in Northern Michigan, belong to the Huronian formation.

From this sketch of the Huronian formation I think it will appear evident that the same particulars characterize it as the corresponding group in Norway, viz: I. The preponderance of quartzose rocks. II. The presence of conglomerates of peculiar character. III. The occurrence of great masses of interstratified diorites or greenstones. IV. The beds of hornstone or chert. V. The presence of copper ores of a high percentage, unmixed with iron pyrites; the veinstone accompanying them being of quartzose. VI. The presence of iron glance (specular iron ore) in the few deposits of iron ore occurring in the group.

In the absence of organic remains, it seems to me that the only means left of identifying the same group in remote localities, is to compare minutely their petrographical and other physical characters. If this view be correct, there can be little doubt but that the quartzose division of the primitive slate formation in Norway, and the Huronian formation of Canada, are identical.

In conclusion, I have to remark with regard to the development of the mineral resources of both formations, that more appears to have been accomplished in this respect in Canada, than in Norway; seeing that the copper mines on the north shore of Lake Huron have had more permanency than those of Tellemarken. Greater progress is probably attributable only to the greater amount of capital which has been invested in the former mines. The obtacles met with have been substantially the same in both countries: the remoteness and inaccessibility of the region from the ordinary markets, and the difficulties in the treatment of the ores. These however have been overcome in this country, and the principal mines on Lake Huron are now well established, and profitably wrought.

PLATE TO ILLUSTRATE THE SPECTRUM DISCOVERIES.

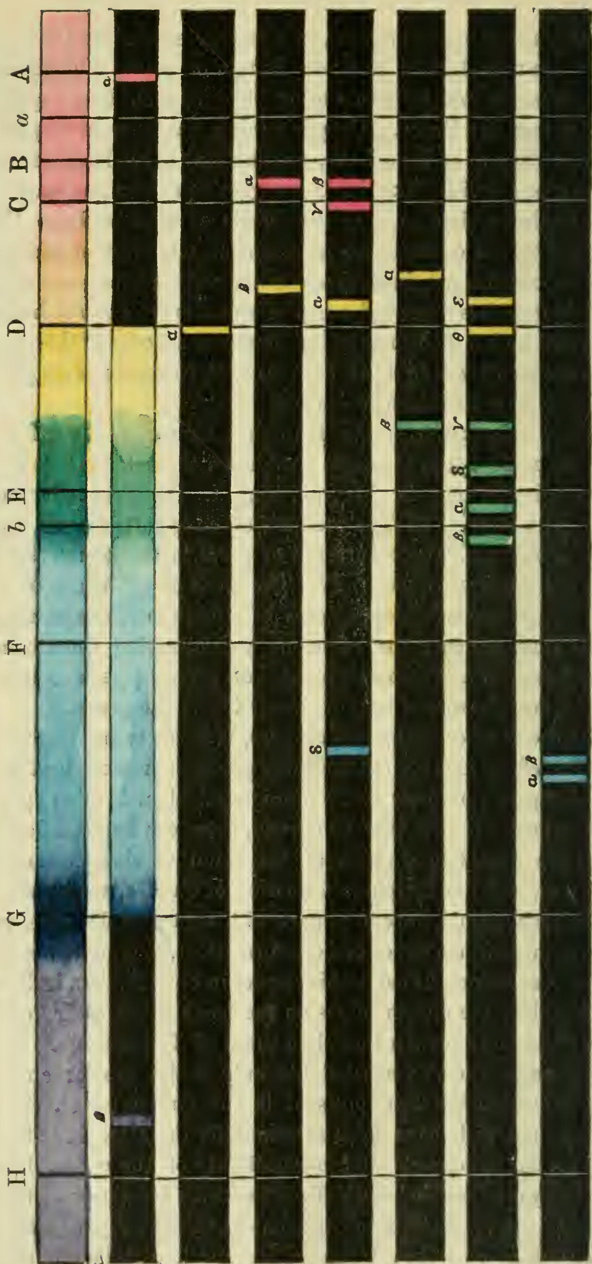

Fig. 1. *Fig.* 2. *Fig.* 3. *Fig.* 4. *Fig.* 5. *Fig.* 6. *Fig.* 7. *Fig.* 8.

ARTICLE X.—*The New Spectrum discoveries.**

We give in this number a series of illustrations† of the spectra of flames, in which salts of Potassium, Sodium, Lithium, Strontium, Calcium, Barium, and Cæsium are volatilized, with the solar spectrum for the sake of comparison.

Fig. 1 represents the solar spectrum, with the most remarkable of Fraunhofer's lines indicated by transverse bars.

Fig. 2 is the potassium spectrum, nearly continuous between Fraunhofer's lines G and D, but showing beyond these limits, two characteristic lines, one named Kα, correspondent to the dark line A, at the red extremity of the solar spectrum, and one Kβ, near the remote extremity of the spectrum, and coincident with another of Fraunhofer's lines. A third line, less distinct, and therefore less valuable for purposes of analysis, coincides with the solar line B.

The sodium spectrum is seen in Fig. 3, and is eminently characteristic. It is distinguished by a single brilliant yellow line Nα, and coincident with the dark solar line D.

Fig. 4 exhibits the peculiarities of the lithium spectrum. It shows an intensely brilliant crimson line Li α, and one less distinct orange line Li β.

The strontium spectrum (Fig. 5), is more complex ; out of eight remarkable lines, six red, one orange, and one blue, four may be particularized, the orange line Sr α, the two red lines Sr β, and Sr γ, and the splendid blue line Sr δ.

The spectrum represented in Fig. 6 is that of calcium, presenting two characteristic lines, the bright green line Ca β, and the intense orange line Ca α.

Of all these spectra, that of barium, represented in Fig. 7, is the most complicated. Three green lines, Ba α, Ba β, Ba γ, are most to be relied on for the determination of this spectrum.

The new metal cæsium, the spectrum of which is represented by Figure 8, was discovered by Bunsen from the appearance of the two blue lines Ca α and Ca β, in the spectrum produced when the residue from the evaporation of the mineral waters of Baden and of Dürkheim was ignited.

Bunsen afterwards announced the discovery of another of new metal, which he names rubidium, and which he detected in a similar manner in the residues of the same mineral waters, by

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* See page 224 of the last volume of *Canadian Naturalist*.

† Reduced from the *London Review*.

the appearance of two red lines beyond the visible red of the solar spectrum. These new metals have since been found widely distributed but in very small proportions. Mr. Grandeau, by the evaporation of several thousand litres of the waters of Vichy, collected about two grammes of the double chloride of platinum and cæsium, and a still smaller proportion of the same salt of rubidium. A larger amount of both these metals is present in the waters of Bourbonne-les-Bains, and the same chimist has found them in different specimens of lepidolite, in the refuse of saltpetre manufactories, and elsewhere. S. P. R.

ARTICLE XI.—List of *Diurnal Lepidoptera* collected (unless otherwise specified) in the immediate vicinity of London, C. W. By W. Saunders.

(Read before the Natural History Society.)

In naming these insects, preference has been given to the family names in the Smithsonian Catalogue, as being the most reliable and easily accessible authority, but where long usage has popularized certain family names they will be found enclosed in brackets.

Papilio turnus, Linn.—Not uncommon.

" *troilus*, Linn.—Common.

" *Philenor*, Linn.—From Rev. Chas. J. S. Bethune, Cobourg. This fine insect taken in such numbers at West Flamboro' by Mr. B. in June 1858, See Canadian Naturalist for August 1858, is not uncommon about Toronto, and has also been taken near Woodstock.

" *Asterias*, Fab.—Common everywhere.

" *Thoas*, Linn.—This splendid butterfly, usually considered peculiarly southern, has been taken in Canada by the Rev. Dr. Sands, of Chatham, C. W. Several years since he captured three specimens on the Mersey, one of which is now in possession of the Lord Bishop of Huron. The Rev. Dr. states that they are not uncommon in that locality, and that they are found through several townships.* He has repeatedly seen specimens on the wing, since the captures above alluded to were made. Although I have no Canadian specimen of *P. Thoas* the fact of its undoubted occurrence in Canada is a matter of too much interest to entomologists to allow it to continue unnoticed.

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* *P. thoas* has also been seen on the wing near Port Stanley, by a resident collector, but the insect being exceedingly difficult to capture, he has never succeeded in taking one.

Pieris Protodice. Boisd.—Common some seasons. Very plentiful last summer.

" *oleracea,* Harris.—Rather scarce around London, but generally common throughout this part of the province.

Terias Lisa, Boisd.—One specimen taken at Port Stanley last August, where it was rare. Mr. T. Reynolds, has sent me a pair from Hamilton, where it appears to be more common.

Danais Archippus, Fab.—Common everywhere.

Argynnis Cybele, Godt.—Usually abundant.

" *Myrina,* Cram.—Common in wet places.

" *Bellona,* Godt.—Common in wet places.

" *Aphrodite,* Godt.—Usually common. Concerning the identity of this species with *A. Cybele* there exists much diversity of opinion. Boisduval states that the difference between them is merely sexual, while other writers regard them as distinct species. They are both undoubtedly subject to considerable variation, and they incline to run into each other, but the larvæ must be made a further subject of study before the opinions of either side can be fully established. In the meantime I must confess I am inclined to look upon them as distinct.

Melitæa Phæton, Cram.—Of this butterfly I have only one specimen, which was taken by a friend last summer at Hall's mills, about seven miles from London. At the time it was captured they were tolerably common in that locality but upon visiting the spot a week or two after not one could be found.

" *ismeria,* Boisd. et Leconte.—Not uncommon, although chiefly confined to one or two favorite spots.

" *Tharos,* Cram.—Abundant.

Grapta (Vanessa) interrogationis, Godt.—Common in the neighborhood of hop-yards.

" " *comma,* Harris.—Not common.

Vanessa J-album,—Boisd. et Leconte.—Generally common, but much scarcer than usual for the last one or two years.

" *Milberti,* Encyc.—Usually abundant.

" *Progne,* Cram.—Common.

" *Antiopa,* Linn.—Plentiful.

Pyrameis (Vanessa) Atalanta, Linn.—Common.

" " *cardui,* Linn.—Usually abundant.

" " *Huntera,* Smith.—Common.

Inonia " *cœnia,* Boisd. et Leconte.—Taken at Port Stanley, August 1861. See Canadian Journal for November 1861.

Nymphalis (Limenitis) Ursula, Fab.—Rare. Of this beautiful insect three specimens have been taken in this vicinity within the last two years. It has also occurred at Port Stanley where it has been somewhat more plentiful.

Nymphalis (Limenitis) Arthemis, Drury.—Not common.
" " *disippus*, Godt.—Common.

Neonympha eurythris, Fab.—Very common in wet places and on the borders of swamps.
" *canthus*, Linn.—Rare. Found usually in swamps.

Erebia nephele, Kirby.—Sent from St. Catherines by D. W. Beadle, Esq., where it is usually plentiful.

Thecla falacer, Godt.—Taken at Port Stanley in August 1861, when it was common in one locality not far from the town.

Thecla niphon, Boisd. et Leconte.—Rare.
" *mopsus*, Boisd. et Leconte.—Not common.
" *laeta*, Edwards (new species).—Rare.
" *acadica*, Edwards (new species).—Very rare. These last two are new species which the collector has had the fortune to discover. They were both taken within a mile of London. Of *T. laeta*, which is a very handsome little creature, two specimens have been taken; of *T. acadica* only one. They will probably be soon described by Mr. Edwards who has named them.

Argus Pseudargiolus, Boisd. et Leconte.—Not common.

Polyommatus comyntas, Godt.—Taken at Port Stanley in August 1861, where it is common some seasons.
" *phleas*, Godt.—Abundant everywhere.
" *thoe*, Boisd. et Leconte.—Generally scarce.

Lycæna Scudderi, Edwards.—This handsome little blue, recently described by W. H. Edwards, Esq., in the *Journal of the Proceedings of the Academy of Natural Sciences*, Philadelphia, is very common in one locality near London. It extends from the cemetery to the Great Western Railway track, and along the line for about a quarter of a mile. Here early in June and again in August it may be taken in considerable numbers.

Goniloba (Eudamus) Tityrus, Smith.—Rare.

Nisoniades (Thanaos) Juvenalis, Smith.—Common.
" " *Catullus*, Smith.—Rare.
" " *Brizo*, Boisd. et Leconte.—Common.

Cyclopidas coras, Cram. (Hesperia otho. Boisd. et Leconte) Not common.

Pamphila viatellius, Smith.—Common.
" *origenes*, Fab.—(Hesperia cernes. Boisd. et Leconte) Common.
" *Zabulon*, Boisd et Leconte.—Abundant.
" *Peckii*, Kirby.—Common.

Hesperia bathyllus, Smith.—Not common.

The collector takes this opportunity of acknowledging his indebtedness to Mr. W. H. Edwards, Newburgh, N. Y. for kindly determining a number of the smaller butterflies.

ARTICLE. XII.—*An account of the Botanical and Mineral products, useful to the Chipewyan tribes of Indians, inhabiting the McKenzie River District.* By BERNARD R. ROSS, H.B.C.S.

(Read before the Natural History Society of Montreal.)

A nation of hunters, paying no attention whatsoever to agriculture, can enjoy but few of the numerous benefits afforded by the vegetable kingdom to the human race in general. Such is the condition of the Chipewyan tribes of Indians. Though the benefits derived from the mighty forests which fill the Mackenzie valley, are but few to their denizens, they may be considered notwithstanding their fewness, to be of essential, indeed of vital importance to the existence of the aboriginal dwellers in these wilds; since without fuel to warm them, and without canoes to migrate, they would soon cease to exist.

From the vegetable kingdom are derived fuel, canoes, sleds, paddles, snow-shoes, baskets, dyes and food, besides other articles which will be noticed hereafter. Two trees, the canoe birch (*Betula papyracea*) and the white spruce (*Abies alba*) stand out, from their importance, in bold relief; but the larch and willow are used also, as well as several kinds of plants, which furnish medicines, dyes, and edible berries that are useful in periods of scarcity. Indeed in summer, a considerable portion of the ordinary food, as well as the luxuries of the natives, is drawn from this source.

According to the method adopted in my former paper on the zoological products, I shall pass the various uses of each species briefly in review :—

The Canoe or Paper Birch (Betula papyracea).—The benefits which this valuable tree confers on the inhabitants of the McKenzie River District, are many and important. Its bark is used in the construction of canoes, and in the manufacture of various utensils for domestic use, such as drinking cups, dishes, and baskets. It also yields spunk or touchwood of the best quality. Of its wood, platters, axe-helves, paddles, snow-shoe-frames, dog-sleds and other articles are made, and as it is a strong and durable material, of close grain, and susceptible of receiving a tolerable polish, the white residents avail themselves of it for the construction of furniture. In spring, the sap forms a pleasant drink, from which a syrup can be manufactured by boiling, and which may be further transformed, by fermentation, into an agreeably flavoured wine of considerable potency. Beyond the arctic circle, the birch is rare

and stunted, though it is found as high as 70° N. The largest and finest trees in the district, grow on the banks of the Liards, or river of the Mountains. Since the advent of missionaries into these wilds, the natives who are Christianized, use the bark for paper on which to engrave their syllabic literature, as well as for letter-writing.

The White Spruce (Abies alba).—This is pre-eminently the forest tree of McKenzie's River District, and grows a considerable distance within the arctic circle, as high as the 69th parallel. It is used for the thin hoops or *verrandis* and lining of bark canoes. With its tough roots split to a convenient thickness, and used under the cree name of *wattape* the pieces of canoe bark are sewed together. Tasteful baskets and dishes are also manufactured from it, as well as kettles capable of containing water. Before the arrival of traders the Indians used these for cooking their food, which was done by dropping heated stones into the water until it boiled. In districts where the birch is scarce, or for temporary use, a rude canoe is made from the spruce. For this purpose, a well grown tree, with thirty feet or so clear of branches, is chosen; an incision is made down to the wood along one side, and the bark being skillfully raised in one piece, receives the canoe shape by being skewered together, and having a few willows inserted for *verrandis* to add to its stiffness. It is serviceable for a short period only, heat and cold being alike destructive to this species of craft, by rendering the spruce bark dangerously brittle. Pieces of the bark are used for covering houses of the white residents, and also by the natives for roofing temporary sheds or cabins. The gum is used for paying the seams of canoes and is chewed by the female aborigines, to the whiteness of whose teeth the habit contributes in no small degree.

From the fibrous bark of the willow a species of twine is made which the natives manufacture into nets of great durability. Sleds are made of the larch and the Banksian pine. The Loucheux Indians use the black seed of the bear-berry for beads, to ornament their dresses with. Alder bark, the wild sorrel, and other shrubs and plants are used for dyes and medicines. While the strawberry, raspberry, gooseberry, mossberry, cranberry, crowberry, mooseberry, red bearberry, the fruit of the rose, and various roots contribute an important item to their summer larder.

Mineral Products.

The mineral kingdom affords but few and unimportant articles for the necessities of the Indians.

Sulphur is found in considerable quantities at the Sulphur Cove on Great Slave Lake. Here sulphur springs occupy a space of several hundred yards in length along the beach. They are very clear, and flow in small rivulets, whose banks are encrusted with a deposit of sulphur which becomes serviceable when thoroughly dried, and is used by the Chipewyan Indians who come to Fort Resolution, in the fabrication of matches.

Common Salt is procured from the salt plains lying about 20 miles up the Salt River, a tributary of the Slave. The springs issue from the base of a long ridge, some hundreds of feet in height, and spreading their waters over a clayey plain, deposit the salt by evaporation in cubical crystals of various degrees of fineness. The mother liquor flows into Salt River, giving a name as well as a most abominable taste to that stream, which is still sensibly brackish at its junction with the Slave. At present, the main supply of salt is confined to one large *jet d'eau* from which a strong brine, mingled with completely formed crystals, is perpetually thrown. Around this spring, evaporation has formed a hillock of dry salt many feet high; and a pole forty feet long was shoved into the spring without finding bottom. Sir John Richardson considers that these fountains belong to the Onondaga Salt group of the Upper Silurian Series of New York.

Numerous bands of buffalo, elk, and reindeer frequent these plains to lick the mineral, of which they are extremely fond. The salt is of excellent quality, strong and well-flavoured. It preserves meat, meal, and butter, fully as well as that imported from England, being far superior to the description manufactured in the plain country of the Swan River District. As the Salt River is very crooked, with generally too little water to float any craft larger than a small canoe, the transport of the salt from the springs to its mouth is by horses.

Ochres, red and blue, are procured at several points in the District, and are used for painting snow-shoes and sleds, by the natives. The Loucheux of the Youcon River paint their faces with these colors in the same way as the tribes of the Plain.

White earth or Pipe-clay is found associated with the coal beds at the mouth of Bear River. When newly dug, it is plastic, but

soon dries. It is eaten in times of scarcity by the natives, and is also used as a soap for washing their clothes, and by the whites for white-washing their houses. At the request of Sir John Richardson it was analyzed by Drs. Davy and Prout, but was not found to contain any nutritious matter.

Mineral Tar is procured at several spots along the Arthabaska or Clear Water River; it is also found on Great Slave Lake, at a short distance N. E. of Big Island, and also near to Fort Good Hope. It is little used by the natives, except to mix with and to soften gum for paying canoes with. It becomes, after being boiled and purified, an excellent tar for boat-building purposes, for which it is used.

Iron Pyrites is found in the Mountain Ranges. The Gens-des-Bois, a tribe living on the banks of the Pelly River, use it instead of flint to strike fire with.

Pieces of Agate are used occasionally as flints, and native copper has been made into knives, spear and arrow heads.

Lignite exists in large quantities near the mouth of Bear River where it is seen in a state of combustion. It is of little value as fuel, and quite unserviceable for forge use. The legend told by the Slave and Dog Rib Indians, of the origin of the fire in these lignite beds is rather curious. The story relates that in the days of old, before Indians roamed the forest, or glided over the waters in their birchen canoes, a giant, tall as a pine tree, dwelt at the eastern end of Slave Lake, then a much larger sheet of water. The giant hungered and he went to hunt. His spear was a tall fir-tree, hardened in the fire, and tipped with native copper. The skins of gigantic elks served him for clothing. Travelling on, he found a beaver-house; the beavers in those days were of extraordinary size, and their houses of corresponding proportions. With great exertion and toil, the house was broken open: it contained two animals, a female and her young. The latter was killed, but the dam escaped, pursued by the giant, who bore the dead cub over his shoulder on the point of his spear. On they sped, until the western end of the lake was reached, where a rocky barrier then stretched across. Through this, the beaver pushed her way, giving vent to the waters of the lake, and thus forming the Tess-chi or McKenzie's River, the flood of which swept her downwards, far out of the pursuer's reach. The giant still continued the chase, until hungry and exhausted, he reached the mouth of Bear River, where he stopped to cook the cub, which was the

size of a moose-deer; and thus lit the fire which continues burning to the present day.

With these I think I have completed this series of notes, in which I believe that nothing of importance to the comfort or welfare of the natives omitted.

Among the Eskimos, the arts and manufactures of savage life are in a much more advanced state than among the Indian tribes, and I trust that I shall, at some future period, have the gratification of laying an account of them before the Natural History Society of Montreal.

ARTICLE XIII.—*List of Mammals, Birds, and Eggs, observed in the McKenzie's River District, with Notices.* By BERNARD R. ROSS, Corresponding Member Nat. His. Soc. Montreal.

(Presented to the Natural History Society.)

MAMMALS.

Order 1.—*Rapacia.*

(Insectivora.)

FAMILY SORECIDÆ.

Genus Sorex.

1. *Sorex Fosteri?* (Richardson).
2. *Sorex palustris?* (Bachm).

This genus is abundant throughout the district as far north as the Arctic coast. I cannot speak confidently as to either the names or the number of the species.

(Carnivora.)

FAMILY FELIDÆ.

Genus Lynx.

3. *Lynx Canadensis* (Rafen).—Canada Lynx—Loup-cervier, of the Canadians—Cat, of the Hudson's Bay residents—Pichen of the Cree Indians and Red River half-breeds—Chée-say of the Chipewyan Indians. This animal is numerous some years, but is migratory, following the hare (Lepus Americanus) its principal food. It ranges to the Arctic coast in summer. In winter, it does not leave the shelter of the woods.

FAMILY CANIDÆ.

(Lupinæ.)

Genus Canis.

4. *Canis griseo-albus* (Rich.)—Strongwood Wolf—Loup-gris, of the Canadians—Mahéecan of the Cree Indians—Nun-dée-yah of the Chipewyan Indians—Mah-nuékh of the Anderson River Eskimos—Yess of the Copper Indians. Of this species I consider that there are two varieties, one of which is

of dark color and large size, inhabiting the wooded portions of the district as far north as the Youcon River. The other is usually a dirty white tint, with in general a dark stripe down the back, and frequents the barren grounds N. to the Arctic cost. It is of smaller size than the first mentioned variety, and lives in much larger bands; Indeed it may possibly be a distinct species.

(Vulpinæ.)

Genus Vulpes.

5. *Vulpes fulvus:* var. *fulvus*, var. *decussatus*, var. *argentatus.* Red. Silver, and Cross Foxes. Ma-kày-sis of the Cree Indians —Naw-kée-thay of the Chipewyan Indians. Pee-sooteh of the Anderson River Eskimos. This species, in all its varieties, is found all over this district to the Arctic coast. They are most numerous around the shores of the lakes, and in swampy tracts on the banks of the larger rivers. In the mountain ranges they are rare. The proportions of the various colors killed in the McKenzie district is as follows: Red $\frac{6}{15}$; Cross $\frac{7}{15}$; Silver $\frac{2}{15}$.

6. *Vulpes lagopus*, var. *Lagopus*, var. *fuliginosus.*—White and Blue Foxes. Both these varieties inhabit the barren grounds and shores of the Arctic coast. The latter is exceedingly rare, much more so than the Silver Fox is in the fulvus species. White Foxes have been killed on the south shore of Great Slave Lake, and a single blue one on the North shore.

FAMILY MUSTELIDÆ.

(Martinæ.)

Genus Mustela.

7. *Mustela Americana* (Turton) —American Sable—Marten-thà of the Chipewyan Indians—Naw-they or Nau-fey of the Slave Indians. Common wherever there are woods, but migratory. The farther north that the skin is obtained, the darker the tint of the fur. On the Youcon River they strongly resemble the Siberian Sable.

8. *Mustela Pennantii* (Erxleben).—Fisher—Pecan of the Canadians. Zhä-cho, or big Marten of the Chipewyan Indians. Rare-Range to 62° north.

Genus Putorius.

9. *Putorius pusillus* (Aud. v. Bach.)—Least Weasel—New York to Big Iceland. Great Slave Lake.

10. *Putorius Cicognanii* (Bonap).—Small brown Weasel. Boston to 62° North. Common.

11. *Putorius? Richardsonii* (Bonap.)—Little Ermine. Boston to Lapierres House. Rather rare.

12. *Putorius? Noveboracensis* (Dekay).—Ermine. Northern New York to 62° north. Rare.

13. *Putorius? longicauda* (Richards.)—Long-tailed Weasel. Upper Missouri to 62° N.; rare. I am far from certain of the identities of the three last species. All the Ermines which are killed in this district have the white of the winter coat slightly tinged with sulphur-yellow.

14. *Putorius vison* (Rich.)—Brown Mink—Teth, jew-say, of the Chipewyan Indians. Trai-ek-puck, of the Eastern Eskimos. Florida to the Arctic coast. Common.

15. *Putorius nigrescens* (Aud. & Bach.)—Little black Mink. Northern New York to 62° north. This species is nothing more than the young of the *P. Vison.*

Genus Gulo.

16. *Gulo luscus* (Sabine).—Wolverine—carcajou—No-gah, of the Chipewyan Indians ;-kha-vig of the Eastern Eskimos. North-New York to Arctic coast. Common.

LUTRINÆ.

Genus Lutra.

17. *Lutra Canadensis* (Sabine).—Otter.—Naw-pée-ah of the Chipewyan Indians. Florida to the Arctic coast. Not uncommon.

MELINÆ.

Genus Mephitis.

18. *Mephitis mephitica* (Shaw).—Common Skunk. Texas to Fort Resolution, Great Slave Lake. I have never seen a living specimen of this animal in McKenzie's River: but I found the bones and a part of the skin of one at a short distance from the shores of Great Slave Lake.

FAMILY URSIDÆ.

Genus Ursus.

19. *Ursus horribilis* (Ord).—Grizzly Bear. Sas-tel-kie of the Chipewyan Indians. Plains of Upper Missouri to Youcon River. Not rare in the mountain ranges.

20. *Ursus Americanus:* var. *Americanus* var. *cinnamoneus* (Aud & Bach). Black and brown Bears: Sas of the Chipewyan Indians. Common throughout to the Arctic circle and beyond. The brown variety is very rare.

21. *Ursus arctos?* Barren-ground bear. Inhabits the barren-grounds and Arctic coasts. Distinguished from the *U. horribilis* by its smaller size and reddish coloration.

22. *Ursus maritimus* (Linn.)—Polar Bear. Nait-suck of the Eastern Eskimos. Common along the Arctic coasts.

Order 5.—*Rodentia.*

Family Sciuridæ.

(Steturinæ.)

Genus Steturus.

23. *Sciurus Hudsonius* (Pallas).—Chickaree. Throughout to within the Arctic circle.

Genus Pteromys.

24. *Pteromys alpinus* (Rocky Mountain flying Squirrel) (Richardson). Found on the mountain ranges of the Liards River. Rather rare.

Genus Tamias.

25. *Tamias quadrivittatus* (Richardson).—Missouri striped Squirrel, from Lat. 53° 30′ to 67° north. Very abundant on the Liards River.

Genus Arctomys.

26. *Arctomys monax* (Gmelin).—Ground-hog. South Carolina to 62° North. Rare.
27. *Arctomys pruinosus* (Gmelin).—N. to Arctic circle. Abundant in the mountain ranges.
28. *Arctomys Kennicottii* (Ross).—This I consider to be a new species, but may be wrong. It is of small size, and inhabits the northernmost ranges of the Rocky Mountains.

(Castorinæ.)

Genus Castor.

29. *Castor Canadensis* (Kuhl).—Beaver. Isă of the Chipewyan Indians. Throughout North America, to within the Arctic circle; very abundant.

Family Muridæ.

(Murinæ.)

Genus Jaculus.

30. *Jaculus Hudsonius* (Wagler).—Jumping Mouse—Pennsylvania to Youcon River. Common at Portage La Sache; rare in McKenzie's River.

Genus Hesperomys.

31. *Hesperomys* (Gapper).—Hamster Mouse. New York to the Arctic Sea, very abundant E. of the Rocky Mountains; not found westward on the Youcon River. This species is very annoying in dwellings, as it carries off quantities of sugar, rice, &c. in its cheek pouches, to store them up for its winter consumption.

Genus Arvicola.

32. *Arvicola riparia* (Ord).—Middle States to Arctic Sea. Common.
33. *Arvicola Richardsonii* (Dekay).—62° north. Rare.
34. *Arvicola xanthognathus* (Leach).—Red-cheeked Arvicole. North to the Arctic Sea. Common.

Genus Fiber.

35. *Fiber zibethicus* (Cuvier).—Musk-rat; Dyin of the Chipewyan Indians. North America to the Arctic Sea, abundant.

FAMILY HYSTRICIDÆ.

Genus Erithezon.

36. *Erithezon dorsatus* (Cuvier).—White-haired Porcupine. From Pennsylvania to within the Arctic circle. Common.

37. *Erithizon epixanthus* (Brandt).—Yellow-haired Porcupine. From Upper Missouri to Liards River.

FAMILY LEPORIDÆ.

Genus Lepus.

38. *Lepus Americanus* (Erxl.)—White Rabbit. Khă of the Chipewyan Indians. From Virginia to within the Arctic circle. Abundant; Migratory.

39. *Lepus glacialis* (Leach).—Arctic Hare—Newfoundland N. to the Arctic Sea; not common.

Genus Lagomys.

40. *Lagomys princeps* (Richardson).—Little Chief Hare—Common among the mountain ranges of the Liards River.

Order 3.—*Ruminantia.*

FAMILY CERVIDÆ.

(Cervinæ.)

Genus Alce.

41. *Alce Americanus* (Jardine).—Moose—Fin-dée-yah of the Chipewyan Indians. New York to within the Arctic circle. Abundant.

Genus Rangifer.

42. *Rangifer caribou* (Aud. & Bach.)—Strong-wood Caribou. From Maine to the Youcon River. Abundant.

43. *Rangifer Groënlandicus.*—Barren-ground Caribou. Barren grounds, and Arctic coasts in spring, summer and autumn. Fringes of the woods in winter.

FAMILY CAVICORNIA.

(Antilopinæ.)

Genus Aptocerus.

44. *Aplocerus montanus* (Richardson).—Mountain Goat. From Northern Cascade Mountains to the Arctic Sea. Not common.

(OVINÆ.)

Genus Ovis.

45. *Ovis montana* (Cuvier).—From the Upper Missouri to within the Arctic circle.

(BOVINÆ.)

Genus Ovibos.

46. *Ovibos moschatus* (Blainville).—Musk ox. Eh-gir-ray-yaz-ey,

(Little Buffalo) of the Chipewyan Indians. Barren grounds and Arctic coast. Not rare.

Genus Bos.

47. *Bos Americanus* (Gmelin).—Bison—North to Little Buffalo River; Great Slave Lake.

Order 4.—Cheiroptera.

48. *Vespertilio subulatus*, (Say.)—North to Salt River. Very rare.

BIRDS.

(Those marked * are winter residents: † Eggs procured.)

Order 1.—Raptores.

Family Falconidæ.

Genus Falco.

1. *Falco anatum*, (Bonap.)—Duck Hawk. North to Slave Lake. Rare.

†2. *Falco columbarius*, (Linn.)—Pigeon Hawk. North to Lapierre's House. Common.

†3. *Falco sparverius*, (Linn.)—Sparrow Hawk. North to Lapierre's House. Rather rare.

Genus Astur.

4. *Astur atricapillus*, (Bonap.)—Black Hawk. North to Fort Good Hope. Rare.

Genus Archibuteo.

5. *Archibuteo sancti, Johannis*, (Gray.)—Black Hawk. North to Salt River. Rare.

6. " *lagopus*, (Gmelin.)—Rough-legged Hawk. North to Lapierre's House. Common.

7. " *ferrugineus?* (Gray.)—Squirrel Hawk. N. to Simpson. Uncertain. Rare.

Genus Buteo.

†8. *Buteo Swainsonii*, (Bonap.)—Swainson's Buzzard. N. to Slave Lake. Rare.

Genus Accipiter.

†9. *Accipiter fuscus*, (Gmelin.)—Sharp shinned Hawk. N. to Simpson. Common.

Genus Circus.

10. *Circus Hudsonicus*, (Lacep.)—Marsh Harrier. N. to Slave Lake. Rather common.

Genus Aquila.

11. *Aquila Canadensis*, (Linn.)—Golden Eagle. N. to Arctic Coast. Rare.

Genus Haliaetus.

†12. *Haliaetus leucocephalus*, (Linn.)—Bald Eagle. N. to Arctic Coast. Common.

Genus Pandion.

†13. *Pandion Carolinensis*, (Gmelin.)—Osprey. N. to Arctic Coast Common.

FAMILY STRIGIDÆ.

Genus Bubo.

*14. *Bubo Virginianus*, var. *subarcticus*, (Swains.)—Horned Owl. N. to Arctic circle and beyond.

Genus Otus.

*15. *Otus Wilsonianus*, (Lesson.)—Long Eared Owl. N. to Fort Simpson. Rare.

Genus Brachyotus.

*16. *Brachyotus Cassinii*, (Brewer.)—Short Eared Owl. N. to Fort Simpson. Common.

Genus Nyctale.

†*17. *Nyctale Richardsonii*, (Bonap.)—Sparrow Owl. N. to Fort Simpson. Rather rare.

Genus Nyctea.

*18. *Nyctea nivea*, (Daudin.)—White Owl. N. to Fort Norman. Rare.

Genus Surnia.

†*19. *Surnia ulula*, (Linn.)—Hawk Owl. N. to Arctic coast. Common.

Order 2 —Scansores.

FAMILY PICIDÆ.

Genus Picus.

*20. *Picus villosus*, (Linn.)—Hairy Woodpecker. N. to Fort Simpson. Common.

*21. " *pubescens*, (Linn.)—Downy Woodpecker. N. to Fort Liards. Not rare.

Genus Picoides.

*22. *Picoides Arcticus*, (Swains.)—Black-backed Woodpecker. N. to Fort Simpson. Rare.

*23. " *hirsutus*, (Vieillôt.)—Banded Woodpecker. N. to Fort Good Hope.

*24. " *dorsalis*, (Baird.)—Striped Woodpecker. N. to Fort Simpson. But one specimen of what I am disposed to consider to be this very rare bird, has been secured. It resembles the *P. hirsutus*, except that the white is marked on the back in longitudinal instead of lateral lines.

Genus Sphyrapicus.

†25. *Sphyrapicus varius*, (Baird.)—Yellow-bellied Woodpecker. N. to Fort Simpson. Common.

Genus Hylatomus.

26. *Hylatomus pileatus*, (Baird ?)—Black Woodcock. N. to Fort Liards, Rare.

Genus Colaptes.

†27. *Colaptes auratus*, (Swains.)—Golden Woodpecker. N. to Peel's River. Common.

Order 3.—Insessores.

FAMILY CAPRIMULGIDÆ.

Genus Chordiles.

†28. *Chordiles popetue,* (Vieillôt.)—Night Hawk. N. to Lapierre's House. Rather rare.

FAMILY ALCEDINIDÆ.

Genus Ceryle.

†29. *Ceryle alcyon,* (Boie.)—Kingfisher. N. to Peel's River. Common.

FAMILY COLOPTERIDÆ.

(Tyranninæ.)

Genus Tyrannus.

30. *Tyrannus Carolinensis,* (Baird.)–King bird. N. to Fort Simpson. Rare.

Genus Sayornis.

†31. *Sayornis fuscus,* (Baird.)—Jewee. N. to Fort Simpson. Rare.

32. " *sayus,* (Baird.)—Say's Flycatcher. N. to Fort Simpson. Rare.

Genus Contopus.

33. *Contopus borealis,* (Baird.)—Olive-sided Flycatcher. N. to Fort Resolution. Rare.

Genus Empidonax.

†34. *Empidonax pusillus,* (Swain.)—N. to Fort Simpson. Rare.

†35. " *Traillii,* (Traill's Flycatcher.)—N. to Fort Resolution. Rare.

†36. " *minimus,* (Baird.)—Least Flycatcher. N. to Fort Simpson. Common.

FAMILY TURDIDÆ. (Oscines.)

(Turdinæ.)

Genus Turdus.

†37. *Turdus Pallasii?* (Cabanis.)—Hermit Thrush. N. to Fort Simpson. Identity uncertain.

†38. " *Swainsonii,* (Cabanis.)—Olive-backed Thrush. N. to Lapierre's House. Abundant.

†39. " *aliciae,* (Baird.)—N. to Youcon River. Only found W. of Rocky Mountains.

†40. " *migratorius,* (Linn.)—Robin. N. to Lapierre's House. Abundant.

(Regulinæ.)

Genus Regulus.

41. *Regulus calendulus,* (Licht.)—Ruby-crowned Wren. Fort Resolution. Rare.

FAMILY SYLVICOLIDÆ.

(Motacillinæ.)

Genus Anthus.

42. *Anthus ludovicianus,* (Licht.)—Tit-Lark. N. to Fort Simpson. Not common.

(Sylvicolinæ.)

Genus Mniotilta.

43. *Mniotilta varia*, (Vieilltôt.)—Black and White Creeper. N. to Fort Simpson. Very rare.

Genus Opornis.

44. *Opornis agilis*? (Connecticut Warbler.)—Fort Simpson. Identity very doubtful.

Genus Helmintophaga.

†45. *Helmintophaga peregrina*, (Cabanis.)–Tennessee Warbler. N. to Fort Simpson.

†46. " *celata*, (Baird.)—Orange-crowned Warbler. N. to Resolution. Rare.

47. " *ruficapilla*, (Wilson.)—Nashville Warbler. N. to Resolution. Rare.

Genus Seiurus.

†48. *Seiurus noveboracensis*, (Gmelin.)—Water Thrush. N. to Lapierre's House. Common.

Genus Dendroica.

†49. *Dendroica coronata*, (Linn.)—Myrtle bird. N. to Lapierre's House. Rare.

†50. " *striata*, (Forster.)—Black-poll Warbler. N. to Lapierre's House. Common.

†51. " *æstiva*, (Gmelin.)—Yellow Warbler. N. to Lapierre's House. Abundant.

†52. " *maculosa*, (Gmelin.)—Black-and-Yellow Warbler. N. to Fort Simpson. Rather rare.

†53. " *palmarum*, (Gmelin.)—Yellow-red-poll Warbler. N. to Resolution. Rare.

Genus Myiodioctes.

54. *Myiodioctes pusillus*, (Wilson.)—Green-Blackcap Flycatcher. N. to Lapierre's House. Very rare.

Genus Setophaga.

†55. *Setophaga ruticilla*, (Linn.)—Red-start. N. to Fort Good Hope. Common.

FAMILY HIRUNDINIDÆ.

Genus Hirundo.

57. *Hirundo horreroum*, (Barton.)—Barn Swallow. N. to Fort Resolution. Rare.

†58. " *lunifrons*, (Say.)—Cliff Swallow. N. to Rat River. Common.

59. " *bicolor*, (Vieillôt.)—White-bellied Swallow. N. to Fort Good Hope. Rare.

Genus Cotyle.

†60. *Cotyle riparia*, (Linn.)—Bank Swallow. N. to Fort Simpson. Abundant.

Family Bombycillidæ.

Genus Ampelis.

†*61. *Ampelis garrulus*, (Linn.)—Wax-wing. North to Youcon River, Not rare. An egg of this bird has been obtained on the Youcon, by Mr. R. Kennicott. I have been informed by Mr. John Hope, a schoolmaster of the Church Missionary Society, resident at Fort Franklin on Bear Lake, that these birds build in numbers in that vicinity; but so high up the trees as to render it a difficult task to obtain the eggs. A specimen was shot in February at Fort Liards, which causes me to mark the species as a winter resident.

Family Laniidæ.

Genus Collyrio.

62. *Collyrio borealis*, (Bon.)—Northern Shrike. N. to Fort Good Hope. Not rare.

63. " *ludovicianus?* (Linn.)—Loggerhead Shrike. Rare. Fort Simpson. Doubtful.

(Vireoninæ.)

Genus Vireo.

64. *Vireo olivaceus*, (Vieilltôt.)—Red-eyed Flycatcher. N. to Fort Simpson. Rare.

65. " *gilvus*, (Bon.)—Warbling Flycatcher. N. to Fort Simpson. Rare.

Family Paridæ.

Genus Parus.

*66. *Parus septentrionalis*, (Harris,)—Chickadee. N. to Fort Simpson. Not rare.

*67. " *atricapillus*, (Linn.)—Blackcap Tit. N. to Fort Simpson. Rare.

*68. " *Hudsonicus*, (Forster.)—Hudson's Bay Tit. N. to Fort Simpson. Not common.

Family Fringillidæ.

(Cocothraustinæ.)

Genus Pinicola.

*69. *Pinicola Canadensis*, (Brisson.)—Pine Grosbeak. N. to Fort Good Hope. Not rare.

Genus Curvirostra.

*70. *Curvirostra leucoptera*, (Gmelin.)—N. to Fort Good Hope.

Genus Aegiothus.

†*71. *Aegiothus Linaria*, (Linn.)—Lesser Red-poll. N. to Fort Good Hope. Abundant.

†*72. " *canescens*, (Gould.)—Mealy Red-poll. N. to Lapierre's House. Common.

Genus Plectrophanes.

(Plectrophanes.)

73. *Plectrophanes nivalis*, (Meyer.)—Snow Bunting. N. to Fort Good Hope. Abundant.

(Centrophanes.)

74. " *lapponicus*, (Selby.)—Long-spur. N. to Fort Simpson.
75. " *pictus*, (Swainson.)—Painted Bunting. N. to Fort Simpson. Rather rare.

(Spizellinæ.)

Genus Passerculus.

*76. *Passerculus Savanna*, (Bon.)—Swamp Sparrow. N. to Fort Simpson. Abundant around Slave Lake.
77. " *Sandwichensis*, (Baird,)—N. to Fort Simpson. Rare.
78. " *Anthinus?* (Baird.)—Great Bear Lake. Uncertain.

Genus Zonotrichia.

†79. *Zonotrichia leucophrys*, (Forster.)—N. to Resolution. Rare.
†80. " *Gambelii*, (Nuttall.)—N. to Lapierre's House. Abundant.
†81. " *albicollis*, (Gmelin.)—N. to Fort Simpson. Rather rare.

Genus Tunco.

82. *Tunco Oregoneus*, (Towns.)—Oregon Snow Bird. N. to Fort Simpson. Rare.
†83. " *hyemalis*, (Sclater.)—Snow Bird. N. to Fort Good Hope.

Genus Spizella.

†84. *Spizella Montecola*, (Baird.)—Tree Sparrow. N. to Lapierre's House. Abundant.
†85.[a] " *socialis*, (Wilson.)—Social Sparrow. N. to Fort Simpson. Abundant.
†85.[b] " *socialis*, (Wilson.)—Striped-crown variety. N. to Fort Simpson. Common.
†86. " *pallida*, (Bonap.)—N. to Fort Resolution. Rare.

Genus Melospiza.

†87. *Melospiza Lincolnii*, (Baird.)—Lincoln's Finch. N. to Fort Simpson. Not rare.
88. *Melospiza palustris*, (Baird.)—Swamp Finch. N. to Fort Resolution. Rare.

(Passerellinæ.)

Genus Passerella.

†89. *Passerella Iliaca*, (Swainson.)—Fox Sparrow. N. to Lapierre's House. Common.

FAMILY ICTERIDÆ.

Genus Molothrus.

90. *Molothrus pecoris* (Swains.)—Cow-bird. N. to Fort Simpson. Very Rare.

Genus Agelaius.

†91. *Agelaius Phœniceus*, (Vieill.)—Swamp Blackbird. N. to Fort Norman.

92. *Agelaius gubernator*, (Bon.)—Red-shouldered Blackbird. N. to Fort Simpson. Common.

93. *Agelaius tricolor*, (Nutt.)—Red and white-shouldered Blackbird. N. to Fort Simpson. Rare.

Genus Xanthocephalus.

94. *Xanthocephalus sterocephalus*, (Baird.)—Yellow-headed Blackbird. Though no specimen of this bird has been procured, I once observed it at Fort Simpson.

(Icterinæ.)

Genus Scolecophagus.

95. *Scolecophagus ferrugineus*, (Swains.)—Rusty Blackbird. N. to Fort Good Hope. Common.

96. *Scolecophagus cyanocephalus* (Cabanis.)—Brewer's Blackbird. N. to Fort Simpson. Not rare.

(Quiscalinæ.)

Genus Quiscalus.

97. *Quiscalus versicolor*, (vieill.)—Crow Blackbird. N. to Fort Simpson. Rare.

FAMILY CORVIDÆ.

Corvinæ.

Genus Corvus.

*98. *Corvus carnivorus*, (Bartram.)—Raven. N. to Arctic coast. Abundant.

99. *Corvus Americanus*, (Aud.)—Common Crow. N. to 61° north lat. Abundant.

(Garrulinæ.)

Genus Pica.

*100. *Pica Hudsonica*, (Bon.)—Magpie. On west of Mountains N. to Lewis and Pelly Rivers. Not seen in the Mackenzie valley.

Genus Perisoreus.

*101. *Perisoreus Canadensis*, (Bon.)—Canada Jay. N. to Lapierre's House Abundant.

Order 4.—Rasores.

(Columbæ.)

FAMILY COLUMBIDÆ.

(Columbinae.)

Genus Ectopistes.

102. *Ectopistes migratoria*, (Swains.)—Wild Pigeon. N. to Fort Norman. Not common.

(Gallinæ.)

FAMILY TETRAONIDÆ.

Genus Tetrao.

*103. *Tetrao Richardsonii*, (Douglas) Black Partridge. N. to Fort Halkett. Only in the Mountains.

†*104. *Tetrao Canadensis*, (Linn.)—Spruce Partridge. N. to Arctic coast. Abundant.

Genus Pediœcetes.

†*105. *Pediœcetes phasianellus*, (Baird.)—Sharp-tailed Grouse. N. to Fort Good Hope.

Genus Bonasa.

†*106*a* *Bonasa umbellus*, (Steph.)—Ruffed Grouse. N. to Fort Simpson. Common.

†*106*b* *Bonasa umbellus*, var. *umbelloides*, (Baird.)—Grey Mountain Grouse. N. to Lapierre's House. Common.

Genus Lagopus.

*107. *Lagopus albus*, (Aud.)—White Ptarmigan. N. to Arctic coast. Common.

*108. *Lagopus rupestris*, (Leach.)—Ptarmigan. N. to Arctic coast. Rather rare.

*109. *Lagopus leucurus*, (Swains.)—White-tailed Ptarmigan. N. to Lapierre's House in the mountains.

Order 5.—*Grallatores.*

(Herodiones.)

FAMILY GRUIDÆ.

Genus Grus.

110. *Grus Americanus*, (Ord.)—White Crane. N. to Fort Simpson. Rare.

†111. *Grus Canadensis*, (Temm.)—Brown Crane. N. to Arctic coast. Common.

112. *Grus fraterculus*, (Cassin.)—N. to Youcon River: but only west of the mountains.

Genus Botaurus.

113. *Botaurus lentiginosus*, (Steph.)—Bittern. N. to Arctic coast. Rare northward.

(Grallæ.)

FAMILY CHARADRIDAE.

Genus Charadrius.

114. *Charadrius Virginicus*, (Bork.)—Golden Plover. N. to Arctic coast. Abundant.

Genus Aegialitis.

115 *Aegialitis semipalmatus*, (Cab.)—Semipalmated Plover. N. to Fort Simpson. Common.

Genus Squaterola.

116 *Squaterola Helvitica*, (Cuv.)—Black bellied Plover. N to Fort Simpson. Rare.

FAMILY HŒMATOPODIDAE.

Genus Strepsilas.

117 *Strepsilas interpres*, (Illig.)—Turnstone. N. to Big Island. Rare.

FAMILY RECURVIVOSTRIDAE.

Genus Recurvirostra.

118 *Recurvirostra Americana*, (Gmelin.)—American Avosit. N. to Fort Rae. Rare.

FAMILY PHALAROPODIDAE.

Genus Phalarophus.

†119 *Phalarophus hyperboreus*, (Temm.)—N. to Fort Rae. Rare.

FAMILY SCOLOPACIDAE.

(Scolopacinae.)

Genus Gallinago.

120 *Gallinago Wilsonii*, (Bon.)—English Snipe. N. to Fort Simpson. Rare.

Genus Macrorhampus.

†121 *Macrorhamphus griseus*, (Leach.)—Red-breasted Snipe. N. to Fort Norman. Rather rare.

122 *Macrorhamphus scolopaceus*, (Lawrence.)—N. to Lapierre's House. Rare.

Genus Tringa.

123 *Tringa maculata*, (Vieill.)—Sack Snipe. N. to Fort Simpson. Common.

124 *Tringa Wilsonii*, (Nuttal.)—Least Sandpiper. N. to Fort Simpson. Rather rare.

†125 *Tringa Buonapartii*, (Schlegel.)—N. to Fort Simpson. Rare.

Genus Calidris.

126 *Calidris arenaria*, (Illiger.)—Sanderling. N. to Big Island. Rare.

Genus Ereunetes.

127 *Ereunetes petrificetus*, (Ill.)—Semipalmated Sandpiper. N. to Fort Simpson. Rare.

Genus Micropalama.

†128 *Micropalma himantopus*, (Baird.)—N. to Fort Simpson. Very rare.

(Totaninae.)

Genus Gambetta,

129 *Gambetta melanoleuca*, (Tell-tale) (Bon.)—N. to Fort Simpson. Rare.

†130 *Gambetta flavipes*, (Bon.)—Yellow legs. N. to Lapierre's House. Abundant.

Genus Ryacophilus.

131 *Rhyacophilus solitarius*, (Bon.)–Solitary sandpiper. N. to Fort Simpson. Common. It is rather a misnomer to call this bird solitary, as I have generally observed them in large flocks.

Genus Tringoides.

†132 *Tringoides macularius*, (Gray.)—Spotted sand-piper. N. to Fort Simpson. Abundant. I have never observed this species to keep in flocks.

Genus Tryngites.

133 *Tryngites rufescens*, (Cabanis.)—Buff breasted sandpiper. Rare. N. to Fort Simpson.

Genus Limosa.

134 *Limosa Hudsonica*, (Swainson.)—N. to Big Island and Fort Rae. Rare.

Genus Numenius.

135 *Numenius borealis*, (Latham.)—Eskimos Curlew. N. to Fort Good Hope. Rare.

FAMILY RALLIDÆ.

Rallinæ.

Genus Porzana.

(Porzana.)

136 *Porzana Carolina*, (Viell.)—Common Rail. N. to Big Island. Rare.

Genus Fulica.

137 *Fulica Americana*, (Gmelin.)—Coot. N. to Fort Simpson. Rather rare.

Order 6.—*Natatores.*

(Anseres.)

FAMILY ANAPIDAE.

(Cygninæ.)

Genus Cygnus.

(Olor.)

138 *Cygnus Americanus*, (Sharpless.)—American Swan. N. to Arctic Coast. Not common.

†139 *Cygnus buccinator*, (Richardson.)—Trumpeter Swan. N. to Arctic Coast. Common.

(Anserinæ)

Genus Anser.

(Chen)

140. *Anser hyperboreus*, (Sallas.)—Snow Goose. N. to Arctic Coast. Abundant.

141. *Anser albatus*, (Cassin,)—North to Fort Resolution. Although no specimen of this Goose is among our collections, I am confident that I have shot it on Slave Lake.

*142 *Anser Rossii*, (Baird).—Ross's Wavy. N. to Fort Resolution. Rather common. There can be little doubt of the existence of these three species of Snow Geese, (exclusive of the Blue Wavy of Hudson's Bay) as the Slave Lake Indians have a different name for each kind. The first which arrives is the middle-sized species which I believe

to be the *A. albatus;* next comes the smallest sort, the *A. Rossii;* and lastly the *A. Hyperboreus*, which arrives when the trees are in leaf, and is called the yellow wavy by the Indians.

(Anser.)

143 *Anser Gambelii*, (Hartlaub).—White-fronted Goose. N. to Arctic Coast. Common.

Genus Bernicla.

†144 *Bernicla Canadensis*, (Boie).—Canada Goose. N. to Arctic Coast. Common.

†145 *Bernicla Hutchinsii*, (Bonap).—Hutchin's Goose. N. to Arctic Coast. Rather common.

*146 *Bernicla Barnstonii ?* (Ross).—This Bird was shot at Fort Simpson. It is of very large size, with the breast of a bright fawn color. The delta of feathers running up into the lower mandible, is white, instead of black as in *B. Canadensis.* The tail is of sixteen feathers. The Indians consider it a species distinct from the Canada Goose. It seldom flies in parties of more than five or six. I cannot however positively state it to be a new species, until the Berniclæ of North America are properly worked up, as our knowledge of them is at present very imperfect.

147 *Bernicla Brenta*, (Stephens).—Brant. N. to Youcon River. From information. This may probably be the *B. nigricans*, (Cassin), as the Youcon has in all likelihood a Pacific Fauna.

(Anatinœ.)

Genus Anas.

†148 *Anas boschas*, (Linn).—Mallard. N. to Arctic Coast. Abundant.

Genus Dafila.

†149 *Dafila acuta*, (Senyns).—Pin-tail. N. to Lapierre's House. Common.

Genus Nettion.

†150 *Nettion Carolinensis*, (Baird).—Green-winged Teal. N. to Peels River. Abundant.

Genus Querquedula.

†151 *Querquedula discors*, (Steph).—Blue-winged Teal. N. to Fort Resolution. Rare.

Genus Spatula.

†152 *Spatula clypeata*, (Boie).—Shoveller. N. to Fort Good Hope. Not common.

Genus Moreca.

†153 *Moreca Americana*, (Stephens).—American Widgeon. N. to Peels River. Common.

(Fuliguline).

Genus Fulix.

154. *Fulix marila*, (Baird).—Big-black-head. N. to Fort Resolution. Rather rare.

†155. *Fulix affinis*, (Baird).—Little-black-head. N. to Peels River. Abundant.

156. *Fulix collaris*, (Baird).—Ring-necked duck. N. to Fort Simpson. Rare.

Genus Aythya.

†157. *Aythya vallisneria*, (Bon).—Canvass Back. N. to Slave Lake. Common.

Genus Bucephala.

†158. *Bucephala albeola*, (Baird).—Spirit duck. N. to Arctic Coast. Abundant.

†159. *Bucephala americana*, (Baird).—Golden-eye. N. to Arctic Coast. Not rare.

Genus Histrionicus.

160. *Histrionicus torquatus*, (Bon).—Harlequin duck. N. to Arctic Coast. Rare.

Genus Harelda.

161. *Harelda glacialis*, (Leach).—South-southerly. N. to Arctic Coast. Abundant.

Genus Malanetta.

†162. *Malanetta velvetina*, (Baird).—Velvet duck. N. to Arctic Coast. Not rare.

Genus Pelionetta.

163. *Pelionetta perspicillata*, (Kaup).—Surf duck. N. to Seels River. Abundant.

Genus Somateria.

164. *Somateria V. nigra*, (Gray).—Slave Lake Eider. A male specimen of this very rare bird was shot by me at Fort Resolution in 1858, and a female was obtained by Mr. Alex. McKenzie in 1861 at the same place. It is exceedingly rare, having never been seen anywhere else in this District.

(Erismaturinæ.)

Genus Erismatura.

165. *Erismatura rubida*, (Bon).—Ruddy duck. N. to Slave Lake. Rare

(Merginæ.)

Genus Mergus.

166. *Mergus serrator*, (Linn).—Red-breasted Merganser. N. to Peels River. Common.

Genus Lophodytes.

167. *Lophodytes cucullatus*, (Reich).—Hooded Merganser. N. to Slave. Lake. Rare.

(Gaviæ).

Family Phalacrocoracidæ.

Genus Graculus.

168. *Graculus dilophus*, (Gray).—Double-crested Cormorant. Slave Lake. Rare.

Family Pelecanidæ.

Genus Pelecanus.

(Cyrtopelicanus.)

169. *Pelecanus erythrorhynchus*, (Gmelin) (American Pelican).—N. to Big Island. Common

Family Laridæ.

(Lestridinæ.)

Genus Stercorarius.

170. *Stercorarius pomarinus*, (Temm).—Pomarine skua. Slave Lake. Very rare.

171. *Stercorarius parasiticus*, (Temm).—Arctic skua. N. to Fort Simpson. Rare.

†172. *Stercorarius parasiticus*, var. *Richardsonii.*—Slave Lake. Rare.

173. *Stercorarius catarractes*, (Temm.)—Slave Lake. Very rare.

174. *Stercorarius cepphus*, (Brünn).–Buffon's skua. N. to Lapierres & Co. Rare.

(Larinæ.)

Genus Larus.

†175. *Larus glaucescens*, (Licht).—Glaucus-winged Gull. Slave Lake. Abundant.

†176. *Larus argentatus*, (Brünn).—Herring Gull. N. to Arctic Coast. Abundant.

†177. *Larus Californicus*, (Lawrence).—California Gull. Slave Lake. Abundant.

Genus Chroicocephalus.

178. *Chroicocephalus Philadelphia*, (Lawrence).—N. to Fort Simpson. Not rare.

Genus Rissa.

179. *Rissa septentrionalis*, (Lawrence).—Slave Lake. Common.

(Sterninæ.)

Genus Sterna.

†180. *Sterna Caspia*, (Pallas).—Caspian Tern. Slave Lake. Rare.

†181. *Sterna Wilsonii*, (Bon).—Wilson's Tern. Slave Lake and Bear Lake. Rather rare.

†182. *Sterna macroura*, (Naum).—Arctic Tern. N. to Bear Lake. Abundant.

Genus Hydrochelidon.

183. *Hydrochelidon plumbea*, (Wils).—Short-tailed Tern. Slave Lake Rare. Numerous other species of the sub-family Lari

næ doubtless exist in this District, which will appear by degrees, as the collections increase.

FAMILY COLYMBIDÆ.

(Colymbinæ).

Genus Colymbus.

184. *Colymbus torquatus*, (Brünnich).—Loon. N. to Arctic Coast. Abundant.

185. *Colympus Adamsi.*—Abundant on Great Slave Lake.

†186. *Colympus arcticus* var. *Pacificus*, (Linn).—N. to Arctic Coast. Rather rare.

187. *Colymbus septentrionalis*, (Linn).—Red-throated Diver. N. to Arctic Coast. Abundant.

(Podicipinæ).

Genus Podiceps.

†188. *Podiceps griseigena*, (Grey).—Red-necked Grebe.—to Peel's River. Common.

†189. *Podiceps cornutus*, (Latham).—Horned Grebe. N. to Lapierres & Co. Common.

190. *Podiceps auritus*, (Lath).—Eared Grebe. Slave Lake. Rare.

Genus Podilymbus.

†191. *Podilymbus podiceps*, (Lawrence).—Slave Lake. Not common.

(Additional.)

192. *Numenius Hudsonicus*, (Latham).—Hudsonian Curlew. Slave Lake. Rare.

The Northern range of the birds means the Northernmost Post at which a specimen has been obtained. I have on hand about 300 specimens, as yet unexamined, among which a few additional species will doubtless be found.

The following other collections have been made :—

Fish. At Fort Resolution, Big Island, Simpson and Bear Lakes, and Fort Liards.

Insects. At Resolution, Simpson, Youcon, Peel's River and Fort Good Hope.

Geological specimens, Fossils, &c., at the Clear Water, Elk, MacKenzie, Anderson, and Rat Rivers, and Slave Lake.

Ethnological specimens. In the District generally.

ARTICLE XIV.—*Notes on Chemical Subjects. By Prof. S. P. Robbins.*

Much attention has been directed within the past ten years to the economical value of silica as a preservative of metals and stone, and as a water-proof, and to some extent fire-proof coating for wood, as well as an important ingredient in the manufacture of artificial stone. Heretofore, however, it has been commonly applied in the form of a solution of the soluble silicate of potash

and soda—the so-called water-glass—the alkali, to which the solubility was due, being removed either by the slow action of the weather, or by chemical agents specially employed for the purpose. Thus superfluous and even injurious compounds were necessarily introduced, which, when removed by solution or efflorescence, left the preservative coating porous and permeable. It is now known, however, that pure silica may in certain cases be dissolved in pure water; thus, if sulphide of silicium be dissolved in water sulphuretted hydrogen is evolved, and silica remains perfectly dissolved and in large amount; or if pure water be separated by a septum of parchment paper from a solution of silicate of soda supersaturated with hydrochloric acid, after a few days the hydrochloric acid and chloride of sodium passing through the septum will leave an aqueous solution of silica on the other side of the diaphragm. It is obvious that such a solution, which may be prepared in many other ways than those here described, will possess many advantages over a solution of water-glass, as a preservative whether of wood or of stone.

As aluminum from its malleability, ductility, tenacity, remarkable lightness, beautiful colour and impassivity to the action of those ever present chemical agents which so rapidly tarnish silver and the commoner metals, promises to become of great economic value, it is gratifying to find that the cost of its production is rapidly diminishing, so that its price has descended from £60 per lb. to 60s., at which price it is now furnished by the Aluminum Works at Newcastle.

Wood publishes in the Journal of the Franklin Institute the following formula for a fusible metal which becomes perfectly liquid at 180°F.; cadmium 1 part, lead 6 parts, bismuth 7 parts. This alloy has a bright metallic colour, is flexible in thin plates, is imperfectly malleable, and about as hard as coarse solder.

ARTICLE XV.—*On the date of the Report on the Geology of Wisconsin, noticed in this Journal, Vol. VI. p.* 465.

In the number of this Journal for December last, there is a notice of one sheet of Prof. Hall's recent Report on the Geology of Wisconsin. On the 12th of March, 1862, two copies of the same report were received at the office of the Geological Survey of Canada, by mail. Both of these are dated January 1, 1861. On one of the copies there are indorsed with pen and ink the

words, "Published Nov., 1861." I do not recognize the handwriting, but it is evident that one of the dates must be incorrect, and I believe both are. I have some evidence that the report was not published until about the middle of December, 1861, eleven months after the date printed on the cover, and I am obliged to call attention to it for the following reasons:

On the 21st of November last, I published a paper containing descriptions of a number of new species of fossils, principally from the Potsdam sandstone and other associated formations. On the 22nd I sent a copy to Prof. Hall by mail. In the January No. of Silliman's Journal, he alludes to it in his letter on the Potsdam sandstone, and Hudson River rocks of Vermont. As a general rule, articles intended for that Journal must be in the hands of the publishers about one month previously to the date of publication. It seems quite certain, therefore, that my paper was in Prof. Hall's possession in the latter part of November, most probably about the 24th of the month. In my paper I described a new genus of fossil Brachiopoda under the name of *Obolella.* One of the species to which I referred as exhibiting the characters of the genus, occurs in the Potsdam sandstone of Wisconsin. Prof. Hall has described this species on p. 24 of his report, under the name of *Lingula polita*, and has also pointed out that its characters are not the same as those of either *Obolus* or *Lingula.* His remarks are in substance the same as mine except that he notices an "obtuse dental process on each side of the rostral cavity," which is not visible in any of our specimens. On comparing the two papers any person would be justified in supposing that I had taken the idea of the genus *Obolella* from Prof. Hall. Thus by antedating his report eleven months, he lays me open to the charge of plagiarism, which is certainly very unfair. I never saw his report, nor had any knowledge of its contents, nor of its existence, until I saw the notice of it in this Journal in the beginning of February, 1862, at which time the December number was issued,—more than two months after my paper was distributed, and fourteen months after the time he has given the public to understand that his was published. I am compelled, therefore, in self-defence, to correct his erroneous date.

Some of my scientific friends have advised me to take no notice of this and similar matters. They, however, are engaged in different fields of research from that occupied by Prof. Hall and myself, and as they cannot come into collision with him, they can

look upon these affairs with the most stoical composure. Were they in my position, they would soon feel their magnanimity very sensibly diminished, and rapidly oozing away from them. For the last four years I have been subjected to great annoyance in consequence of Prof. Hall's extraordinary practice of antedating his publications, and I have a perfect right, and shall not hesitate on every occasion, to resist in the most public manner.

E. Billings.

Montreal April 15, 1862.

REVIEWS AND NOTICES OF BOOKS.

A Manual of the Sub-Kingdom Cœlenterata. By Joseph Reay Greene, B.A., Professor of Natural History in the Queen's College, Cork. London, 1861. Longman & Co. 12mo, pp. 271.

"The author of this work is already favourably known by his "Manual of Protozoa," with a general introduction on the Principles of Zoology—which is an excellent text-book for students. The present volume is an abridgment of a larger work, which the author hopes ere long to publish. The Cœlenterata include such animals as the Hydra, Sertularia, Medusa, Actinia, and Zoophyte. They are all furnished with an alimentary canal, freely communicating with the general or somatic cavity. The substance of the body consists essentially of two separate layers; an outer, or ectoderm, and an inner, or endoderm. These two membranes, but especially the former, are in general provided with ciliæ. In the integument of those organisms we constantly meet with peculiar thread-cells, which, when they come into contact with the human skin, frequently produce disagreeable stinging sensations. The sub-kingdom is divided into two orders:—1. *Hydrozoa*, in which the wall of the digestive sac is not separated from that of the somatic cavity, and the reproductive organs are external; 2. *Actinozoa*, in which the wall of the digestive sac is separated from that of the somatic cavity by an intervening space, subdivided into chambers by a series of vertical partitions, in the faces of which the reproductive organs are developed. The author gives the morphology, physiology, classification, and distribution as regards space and time, of the animals included in these two orders. The facts are stated in a clear and interesting manner, and are

illustrated by numerous excellent woodcuts. The author has given the most recent observations in regard to the anatomy and physiology of the animals, and has produced a manual of great value to the student of zoology, to whom these lower types of animals must ever present attractive subjects for observation. Physiology is indebted in no small degree for its progress to the labours of naturalists who have made researches into the functions of these animals, and we do not know any department of natural history more deserving of attention. Much has been done of late years in the illustration of the various divisions of the Cœlenterata by Forbes, Allman, Huxley, Hincks, Busk, Strethill, Wright, Gosse, Agassiz, Sars, Siebold, Steenstrup, Müller, Milne-Edwards, Gegenbaur, Leuckart, and others. We have much pleasure in recommending Mr. Greene's work as an excellent epitome of all that has been done by these authors. There is a valuable bibliography appended, along with a series of questions which are well calculated to test the student in regard to his knowledge of the subject."—*Edinburgh New Philosophical Journal.*

Scripture and Science not at variance; with Remarks on the Historical Character, Plenary Inspiration, and Surpassing Importance of the Earlier Chapters of Genesis. By John H. Pratt, M.A., Archdeacon of Calcutta. 4th Edition, London: Thomas Hatchard. 1861. 8vo, pp. 158.

"It has often been said that the discoveries of science are at variance with the statements of Scripture, and it is sometimes difficult for those who believe in the inspiration of the sacred volume to repel the charge made against it by sceptical men of science. The object of Archdeacon Pratt's work is to present such persons with a reply in a concise and portable form. It points out the difficulties to be met with and the objections to be removed, and tends to strengthen the faith of those who believe the Word of God. The author gives instances in which Scripture and science were supposed to be antagonistic, but which were cleared up by subsequent discoveries. He then enters on an examination of the earlier part of the Book of Genesis, and concludes that no new discoveries, however startling they may appear at first, need disturb our belief in the plenary inspiration of the sacred volume, or damp our ardour in the pursuit of science. The vexed questions in regard to the six days of creation, the origin of man and of

species, of death before Adam, the nature of the Deluge, the origin of languages, are ably handled. Many apparent discrepancies are explained, and several false theories are exposed. The author writes as a man of science, and at the same time a believer in the Bible; and he supports his views by able and judicious arguments. "The *hasty* and *immature* deductions of science may sometimes stand in opposition to Scripture; but their *settled* results, in which the body of philosophers agree, often confirm and illustrate the statements of the inspired Volume. Let us then hold firm our grasp upon this truth, that the Scriptures are the infallible Word of God, true in every statement they contain, although the interpretation sometimes demands more knowledge than we at present possess; but let us at the same time remember, that there is no ground whatever for ceasing to pursue science, in all its branches, with an ardent and fearless mind. God's Word and Works never have contradicted each other, and never can do so. The progress of science in inevitable, and it is the glory of man's intellectual endowments. It is the setting forth of the greatness and wisdom of the Creator in His works. Let us therefore push on investigations to the utmost with untiring energy. We have nothing to fear. The greatest perplexities may at any time surround us; but both reason and experience have armed us with arguments which assure us that all will be right. Whatever happens, let our persuasion always be avowed, that Scripture cannot err. Let us be content rather to remain puzzled, than to abandon, or even question, a truth which stands upon so immovable a basis."—*Edinburgh New Philosophical Journal.*

Erratum.—On Page 87 last line, for "*Plectrophanes nivalis*" read "*Fringilla nivalis*, Wilson."

MONTHLY METEOROLOGICAL REGISTER, ST. MARTINS, ISLE JESUS, CANADA EAST, (NINE MILES WEST OF MONTREAL,) FOR THE MONTH OF FEBRUARY, 1861.

Latitude, 45 degrees 32 minutes North. Longitude, 73 degrees 36 minutes West. Height above the level of the Sea, 118 feet.

BY CHARLES SMALLWOOD, M.D., LL.D.

Day of Month.	Barometer—corrected and reduced to 32° F. (English inches.)			Temperature of the Air.—F.			Tension of Aqueous Vapour.			Humidity of the Atmosphere.			Direction of Wind.			Horizontal Movement in 24 hours. In miles.	OZONE. Mean amount of, in tenths.	RAIN. Amount of, in inches.	SNOW. Amount of, in inches.	WEATHER, CLOUDS, REMARKS, &c. &c. [A cloudy sky is represented by 10, a cloudless one by 0.]		
	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.					6 a. m.	2 p. m.	10 p. m.
1	30.177	29.977	29.992	— 4.0	28.4	17.4	.024	.142	.087	.45	.88	.84	N. E. by E.	N. E. by E.	N. E. by E.	64.70	3.0		1.10	Cu. Str. 10.	Snow.	Snow.
2	205	30.250	30.349	6 0	20.5	6.0	.087	.075	.040	.64	.70	.70	N. N. W.	N.	N.	64 80	1.5			Clear.	Cirr. Cum. 4.	Clear. Zodiacal Light Bright.
3	364	339	197	—17.1	12.1	4.9	.008	.045	.032	.40	.60	.60	E. by S.	N. E. by E.	N. E. by E.	18.30	1.0			Clear.	C. C. Str. 8.	Snow.
4	139	112	254	4.1	14.2	4.5	.038	.061	.038	.73	.73	.73	N. E. by E.	N. E. by E.	S. S. E.	189.40	3.0	Inapp.	0.57	Cu. Str. 10.	Cu. Str. 6.	Cu. Str. 10.
5	367	279	258	—12.1	18.9	8.1	.012	.077	.048	.50	.76	.77	S. S. E.	S. E.	S. S. E.	2.70	2 5			Hoar frost.	Clear.	Clear. Imp. Lunar Halo.
6	046	29.769	29.085	1.0	24.1	17.1	.032	.094	.078	.70	.73	.85	N. E. by E.	N. E. by E.	N. E. by E.	119.00	4 5		0.51	C. C. Str. 4.	Cu. Str. 10.	Snow.
7	29.759	862	30.069	14.1	21.0	14.8	.067	.075	.051	.81	.71	.65	W.	W. N. W.	W. N. W.	293.30	2 6		1.10	Cu. Str. 10.	" 6.	C. C. Str. 4.
8	30.008	30.096	29.988	0.0	24 0	11.0	.030	.094	.018	.69	.73	.69	N. W.	N. W.	N. W.	27 20	1.5			Clear.	" 2.	" 10. Lunar Halo.
9	29.885	29.847	994	0.0	27.0	10.3	.034	.111	.049	.71	.75	.70	S. by E.	S. W.	S. W.	8.30	1 5			Str. 2.	Clear.	Clear.
10	30 008	949	960	—17.0	15.6	— 5.4	.011	.065	.030	.51	.74	.82	N. E. by E.	E. by E.	E. S. E.	1.90	1.0			Clear.	"	C. C. Str. 8. Lunar Corona.
11	29.840	757	690	— 4.7	17.0	11.0	.029	.053	.067	.82	.58	.70	N. E. by E.	N. E. by E.	N. E. by E.	68.00	2 0			C. C. Str. 4.	Cu. Str. 4.	C. Cirr. 4. Lunar Halo.
12	560	644	762	18.0	28.8	27.7	.078	.127	.129	.81	.76	.88	S. S. E.	W.	S. W.	57 50	3.0		1.17	Snow.	C. C. Str. 4.	Cu. Str. 10.
13	990	951	923	1.1	17.4	14.1	.088	.047	067	.85	.50	.81	W.	S. S. W.	N. E. by E.	48.80	2 0		0.51	Clear.	Cu. Str. 10.	C. C. Str. 10.
14	778	700	30.004	16.0	24.7	4 2	.080	.105	.036	.91	.80	.70	N.	N. by W.	W. by N.	122.10	3 0		0.77	Snow.	C. C. Str. 4.	Clear.
15	30.115	997	29.952	—19.9	14.0	7.9	.002	.051	.048	.67	.63	.77	S. S. E.	N. E. by E.	N. E. by E.	29.30	2.0			Cu. Str. 4.	Cu. Str. 4.	C. Str. 4. Imp. Solar Halo.
16	106	30.300	30.382	2.0	19.0	3.8	.034	.061	.026	.71	.60	.57	W. by N.	W. by N.	W. by N.	138.40	2 0			Clear.	Clear.	Clear.
17	427	325	190	— 2.1	19.7	10.6	.027	.081	.048	.67	.77	.69	S. S. E.	S. S. E.	N. N. E.	33.10	1.5			Cirr. Str. 4.	Cu. Cir 4.	"
18	29.845	29.764	030	12.5	34 0	25.0	.060	.155	.105	.80	.79	.80	N. E. by E.	W. S. W.	W. by S.	148 10	3.0		1.14	Snow.	Cu. Str. 8.	Clear. Zodiacal Light Bright.
19	30.204	30.154	29.949	10.0	25.3	19.4	.054	.105	.093	.78	.80	.92	S. E.	N. E. by E.	N. E. by E.	46.90	2.5			Cu. Str. 10.	" 2.	Cu. Str. 10.
20	29.747	29.714	791	16.1	21.4	9.9	.074	.090	.050	.84	.78	.76	N. E. by E.	W.	W.	190.00	2.0		4.14	" 4.	" 4.	Clear. Au. Bor. & Zod. Lt. Bright.
21	30.174	30.111	30.047	2.0	31.0	20.2	.034	.166	.090	.71	.78	.84	W. by S.	W. S. W.	W. S. W.	247.66	1.0			Clear.	" 2.	Cu. Str. 10.
22	29.882	29.814	29.084	16.0	34.2	20.0	.073	.155	.097	.82	.79	.92	E. by N.	W.	S. by E.	5.00	1.5		Inapp.	Cu. Str. 10.	Clear.	Clear.
23	734	679	620	18.0	37.9	32.1	.082	.177	.162	.84	.80	.89	S. W.	S. W.	W. S. W.	28.70	1.0			" 8.	Cu. Str. 10.	Cu. Str. 10.
24	431	324	679	31.1	27 9	7.1	.155	.117	.045	.89	.77	.76	N. E. by E.	N. E. by E.	W.	283.16	3.0		12.16	Snow.	Snow.	" 10.
25	30.103	30.152	30.206	—11.1	16.4	5 5	.014	.059	.016	.54	.66	.87	W. by N.	W. by N.	W. by N.	525.20	1.5			Clear.	Clear.	Clear. Zodiacal Light Bright.
26	090	29.901	29 769	—10.1	25 6	2.0	.017	.094	.031	.57	.68	.71	S. S. W.	S. W.	S. S. W.	37.80	1 0			"	"	" " " "
27	29.614	507	578	4.0	20.0	17.4	.038	.081	.073	.75	.77	.75	N E. by E.	W. S. W.	W. S. W.	124.59	2.0		1.10	Cu. Str. 10.	Snow.	Snow.
28	490	474	513	14.0	28.4	22.0	.067	.123	.101	.81	.82	.86	W. S. W.	W. S. W.	W.	241.60	2.0		3 50	Snow.	"	Cu. Str. 10.

REPORT FOR THE MONTH OF MARCH, 1862.

Day of Month.	Barometer—corrected and reduced to 32° F. (English inches.)			Temperature of the Air.—F.			Tension of Aqueous Vapour.			Humidity of the Atmosphere.			Direction of Wind.			Horizontal Movement in 24 hours. In miles.	OZONE. Mean amount of	RAIN. Amount of, in inches.	SNOW. Amount of, in inches.	WEATHER, CLOUDS, REMARKS, &c., &c. [A cloudy sky is represented by 10, a cloudless one by 0.]		
	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.					6 a. m.	2. p. m.	10 p. m.
1	29.679	29.700	29.791	11.1	23.0	19.1	.057	.095	.077	.79	.79	.77	W. S. W.	W.	W.	302.70	2.5		0 75	Snow.	C. C. Str. 4.	Cirr. Str. 10.
2	929	942	952	17.1	32.1	15.0	.078	.143	.161	.87	.79	.73	W. by S.	W.	W.	76.70	1.5			Cirr. Cum. 4.	Clear.	Clear. Zodiacal Light Bright.
3	920	814	742	— 3.1	32 1	25.6	.025	.143	.111	.66	.79	.81	E.	N. E. by E.	N. E. by E.	0.70	2.5			Clear.	C. C. Str. 4.	Cu. Str. 10.
4	318	420	507	33.1	34.6	24.6	.168	.162	.105	.89	.84	.80	N. E. by E.	N. E. by E.	N. E. by E.	363.50	3 5		1.85	Snow.	Cu. Str. 10.	Snow.
5	498	500	504	23.0	31.4	24.1	.106	.130	.111	.86	.74	.86	W. S. W.	W. S. W.	W. by W.	330.00	3 5		5 00	"	Snow.	Cirr. Str. 10.
6	511	574	601	22.1	41.0	28.0	.098	.212	.135	.78	.82	.86	W. S. W.	S. W.	W. by W.	119.70	3.5		1.09	Cu. Str. 10.	Cu Str. 10.	Snow.
7	662	741	779	20.0	50.1	35.2	.091	.283	.182	.83	.78	.89	W. by S.	W. S. W.	W.	34 10	2.0			Fog.	Clear.	Cirr. Str. 2.
8	823	947	30.051	26.2	56.2	34.2	.126	.391	.160	.86	.87	.86	W. by S.	S. W.	S. W.	10.40	1.5			Cirr. Str. 8.	"	Clear.
9	30 152	30.147	002	24 1	49.7	34.2	.094	.265	.155	.76	.74	.80	S. W.	W.	S. W.	10.60	1 5			Clear.	"	C. C. Str. 10.
10	29.790	29.592	29 417	33.1	36.7	34 7	.168	.164	.169	.89	.76	.84	S. by E.	S. by E.	S. E.	203.60	3.5	0.581		Rain.	Rain.	Rain.
11	800	807	901	30.0	36.4	30.0	.130	.170	.132	.78	.80	.79	S. E.	N. W.	S. W.	242.50	3 5			Cu. Str. 4.	C. C. Str. 4.	C. Cum. 4. Lunar Halo.
12	802	789	30.064	21.4	39.7	21.3	.105	.188	.095	.80	.77	.79	W. by S.	N. by W.	N. N. E	201.10	2 5		0.40	Cirr. 4.	Snow.	Str. 2.
13	30.211	30.279	243	6.4	30.3	26.1	.040	.124	.120	.70	.73	.86	W. S. W.	S. S. W.	N. E. by E.	44.20	1 5		0.09	Clear.	Cirr. Cu. 4.	Snow.
14	057	030	037	25.1	30.4	23.4	.117	.146	.106	.88	.87	.86	N. E. by E.	N. E. by E.	N. E. by E.	200.50	3.5		0.63	Snow.	Snow.	Cu. Str. 10.
15	29.934	29.817	29 719	24.2	30.4	23.4	.111	.142	.100	.86	.84	.79	N. E. by E.	N. E. by E.	N. E. by E.	326.90	4 0		3.98	Cu. Str. 10.	"	" 10.
16	609	579	600	21.1	27.0	26.1	.085	.105	.117	78	.70	.82	N. E. by E.	N. E. by E.	N. E. by E.	641.40	2.0			" 10.	Cu. Str. 10.	Snow.
17	647	727	734	24.1	27.9	24 2	.111	.117	.094	.76	.74	.87	N. E. by E.	N. E. by E.	N. E. by E.	403.60	3.0		1.47	" 10.	Light snow.	Slight Snow.
18	999	30.074	30.027	25.1	45 6	24.3	.117	.245	.094	.87	.80	.73	N. E. by E.	S. S. W.	N. N. E.	6.90	1 5		0.74	C. C. Str. 4.	Clear.	Str. 4.
19	30 079	29.977	054	6.1	39.0	19.0	.029	.195	.072	.51	.82	.70	N. E. by E.	W. S. W.	E. S. E.	24.70	1 0			Str. 4.	Cu. Str. 4.	Clear. Zodiacal light. Au. Borealis.
20	29.977	997	002	7 4	43 0	34 2	.040	.209	.162	.64	.75	.60	S. S. W.	S.	E. N. E.	0.00	1 0			Clear.	Clear.	"
21	834	730	20.048	20.1	34.6	32.0	.091	.169	.162	.85	.84	.89	N. N. E.	N. E by E.	S. E.	79.30	2.5		1.75	Cu. Str. 10.	Snow.	Snow.
22	440	437	432	30.0	36.4	35.4	.136	.170	.189	.83	.80	.92	N. E. by E.	N. E. by E.	N. E. by E.	1.10	2.0			" 4.	Cu. Str. 4.	Sleet.
23	519	574	637	33.4	50.0	34 2	.162	.283	.162	.84	.78	.84	S. E. by E.	S. E.	S. W.	0.30	1 8			" 10.	C. C. Str. 10.	Nimb. 10.
24	496	644	630	32.4	42.6	32.0	.175	.194	.143	.89	.74	.79	W.	S. W.	W. S. W.	0.10	2.5	0.010		C. C. Str. 8.	Cu. Str. 4.	Clear.
25	727	751	804	31.1	36.0	28.8	.140	.156	.111	.80	.75	.71	W.	W. S. W.	W.	183.20	1.0			Cu. Str. 2.	Clear.	C. C. Str. 8.
26	807	900	952	28.4	42.7	23.0	.129	.193	.087	.83	.71	.72	S. W.	S. S. W.	W.	159.00	1.0			Clear.	"	Clear. Aurora Borealis.
27	927	841	960	14.1	52.0	35.0	.051	.315	.183	.63	.83	.90	W. by S.	S. S. W.	S. W.	50.70	1.0			"	"	Cu. Str. 4.
28	824	917	30.050	17.1	32.9	26.2	.068	.137	.105	.75	.73	.75	W.	N. E. by E.	N. E.	314.70	1.6			C. C. Str. 4.	"	Clear. Zodiacal Light Bright.
29	30.124	30.121	120	15 7	42.4	32.4	.065	.215	.143	.74	.79	.79	W. S. W.	W. S. W.	W. S. W.	22 20	1.9			Clear.	"	"
30	097	109	29.917	18 7	48.1	32 1	.077	.234	.143	.76	.80	.79	W. S. W.	W. S. W.	S. S. E.	4.90	1.0			"	C. Cirr. 4.	"
31	29.821	29.820	924	32.6	60.2	34.2	.175	.203	.162	.94	.82	.84	S. S. E.	S.	E. by N.	207.20	2.5	Inapp.	Irapp.	Snow.	Sleet.	Cu. Str. 10.

REMARKS FOR FEBRUARY, 1861.

Barometer .... Highest, the 17th day, 30·427 inches.
Lowest, the 6th day, 29.085 "
Monthly Mean, 29.943 day, "
" Range, 1.342 "

Thermometer ... Highest, the 23rd day, 37°9.
Lowest, the 15th day,—19°9.
Monthly Mean, 18°25.
Monthly Range, 57°8.

Greatest intensity of the Sun's rays, 78°8.
Lowest point of Terrestrial radiation,—20°4.
Mean of Humidity, .740.
Rain fell on 1 day, Inapp.

Snow fell on 13 days amounting to 27.77 inches; it was snowing 101 hours 44 minutes.
Most prevalent wind, N. E. by E.
Least prevalent wind, the E. by S.
Most windy day the 25th day, mean miles per hour, 20.88.
Least windy day the 5th day, mean miles per hour, 0.11.
Aurora Borealis visible on 1 night.
Zodiacal Light bright and well defined.
3 Lunar Haloes and 1 Corona seen.
1 Solar Halo.
The Electrical state of the Atmosphere has indicated moderate intensity.
Crows 1st seen on the 10th day.

REMARKS FOR MARCH, 1862.

Barometer. ...... Highest, the 13th day, 30.279 inches.
Lowest, the 4th day, 29.318 "
Monthly Mean, 29.858 "
Monthly Range, 0.961 "

Thermometer. Highest, the 27th day, 52°0.
Lowest, the 3rd day,—4°1.
Monthly Mean, 29°29.
Monthly Range, 56°1.

Greatest intensity of the Sun's rays, 73°1.
Lowest point of Terrestrial radiation,—5°7.
Mean of humidity, ·793.
Rain fell on 4 days, amounting to 0.621 inches; it was raining 34 hours.

Snow fell on 12 days amounting to 17·75 inches; it was snowing 128 hours and 50 minutes.
Most prevalent wind, N. E. by E.
Least prevalent wind, E.
Most windy day, the 16th day; mean miles per hour, 28,74.
Least windy day, the 20th day; Calm.
Aurora Borealis visible on 2 nights.
Solar Halo visibls 1 day.
Lunar Halo visible 1 night.
Zodiacal light frequently very bright.
The Electrical state of the Atmosphere has indicated feeblo intensity.

THE

CANADIAN

NATURALIST AND GEOLOGIST.

VOL. VII. JUNE, 1862. No. 3.

ARTICLE XVI.—*On the Primitive Formations in Norway and in Canada, and their Mineral Wealth.* By THOMAS MACFARLANE.

(*Continued from page* 127.—*Conclusion.*)

II. THE PRIMITIVE SLATE FORMATION.

B : *The Schistose Group.*

The second or schistose division of the Primitive Slate Formation in Norway, may be said to exist, with certainty, in two distinct areas, the one to the northeast and southeast of Vestfjord, in the Nordlands, and the other to the northeast, west, southeast, and south of Trondhjem. Keilhau describes the former of these regions as "The Mica Schist districts of Tromsen and Senjen." The latter region he includes in what he entitles "The Norwegian portion of the central transition territory of the Scandinavian Peninsula," because it appears, through transitions, to stand in intimate connection with the fossiliferous Silurian strata, which are developed around the northern end of Mjösen Lake. Believing however, with Naumann, that although the division line between the two formations, may sometimes become very indistinct, nevertheless, "on careful examination its existence will be found in most cases, capable of demonstration," I have assumed, with him, that the strata of the last mentioned region belongs to the Schistose Group of the Primitive Slate Formation.

The rocks of which they are composed are given in the following list, in the order of the frequency of their occurrence.

1. *Mica schist*, "a slaty crystalline mixture of mica and quartz,"* occurring most frequently and characteristic in the districts of Tromsen and Senjen. It is, however, often found of a more equivocal character, and is then called micaceous schist. It presents numerous transitions into the other schistose rocks of the group. Thus, gradually becoming fine-grained, it passes into clay slate, micaceous clay slate, or argillaceous mica schist, and by the disappearance of the mica, through quartzose mica schist, into quartz slate. Similarly, when chlorite and talc occur in it, it often becomes a chloritic or talcose mica schist; the former of these being the most frequent.

2. *Clay slate*, "an impalpable (indistinctly mixed,) distinctly foliated, soft rock; generally of a greyish, greenish, or bluish color,"† appears to be, next to mica schist, the most frequently occurring rock. It is however, more developed in the districts around Trondhjem, and is of a more variable character than even the mica schist. Besides the many varieties that may be included under the general term of argillaceous slate, which is frequently applied to these rocks, there occurs a clay slate, described as being both micaceous and chloritic, (Chloritischer Thonglimmerschiefer); from which it appears that, even mechanically, the same substances are distinguishable in some clay slates, which Sauvage found by chemical analysis to be present in the slates of the Ardennes; viz., a chloritic mineral which was decomposed by hydrochloric acid, with a micaceous mineral decomposable by sulphuric acid, and quartz.‡

3. *Chlorite schist*, "a soft schistose, mostly greenish colored rock, consisting principally of chlorite. Quartz or feldspar, or both together, are however frequently mixed with the chlorite."|| It is often found in its characteristic form, but is also frequently described merely as chloritic schist, and occurs principally in the districts around Trondhjem.

4. *Limestone* comes next in frequency. It is developed especially in the districts of Tromsen and Senjen, where its texture varies from granular to impalpable, and its colour from white to dark grey. The limestone of the districts around Trondhjem, is mostly yellowish-white, and of an impalpable, sometimes slaty structure.

* Lehrbuch der Geognosie II, 281.
† Cotta: Gesteinslehre, p. 140. ‡ Idem, p. 147.
‡ Ann: des Mines VII, 441.
|| Cotta: Gesteinlehre, p. 145.

5. *Quartz slate and Quartzite*, appear as transitions from mica schist, in the manner above referred to.

6. *Gneiss*, more or less characteristic, occurs in the group, especially towards the junction with the Primitive Gneiss Formation.

7. *Hornblende schist*, occurs in the Trondhjem region, and also in more northern districts. In both, it is connected with, and forms transitions into diorite.

8. *Diorite* and other *Greenstones*. Diorite is "a crystalline, granular mixture of hornblende and albite, sometimes also slaty or porphyritic."* Most of the greenstones in this group seem to be diorites. They are, however, often of very variable characters, and by the substitution of diallage for hornblende, graduate into a species of diabase.

9. *Granite and Syenite*, are also eruptive rocks occurring in the group, sometimes intimately associated with the diorites. *Hornblendic granite*, a connecting link between granite and syenite, and *granulite* are also mentioned.

10. *Serpentine* sometimes occurs in considerable masses. It is confined to the schistose districts south of Trondhjem, and consists of the common dark-coloured variety, differing altogether from the light coloured serpentines of the Primitive Gneiss Formation. Chromic iron ore invariably accompanies it.

11. *Euphotide*; a rock thus named is described by Keilhau, as containing large grained diallage or hypersthene. This is however a feldspathic rock, and by reference in a note in a former portion of this paper, p. 17, it will be seen that it is to be regarded as a kind of diabase, and distinct from the true euphotides of the Alps.

12. *Talc schist.*

13. *Steatite or Soapstone.* This, together with the rocks yet to be enumerated, is of comparatively rare occurrence.

14. *Dolomite.*

15. *Conglomerates and breccias*, somewhat resembling in character those already described in the quarztose division of the schistose formation.

The rocks above enumerated form, as already mentioned, two distinct geographical regions, which differ also in petrographical characters. The first is the one already mentioned, of Tromsen

* Cotta: Gesteinlehre, p. 57.

and Senjen, where the preponderating rock is mica schist; with which limestone, more or less granular, is very generally interstratified. Besides these, more or less characteristic gneiss, hornblende, chlorite, and talc schist occur as subordinate constituents. Well-defined clay slate is of comparatively rare occurrence, although the mica schist often assumes an argillaceous character.

The second region is that spread out to a considerable distance, in the directions before mentioned, around Trondhjem. In this also the mica schist may be termed the preponderating rock, but the interstratified limestone is less frequent. Moreover clay slate and chloritic schist are of far greater frequency than in the first named district, as is also serpentine; which latter rock may be said to be characteristic of the second district, especially of that part of it which constitutes the Dovrefjeld Mountains. The serpentine masses seem to be irregularly interstratified with the slates, and sometimes to graduate into them. The greenstones and granites, besides occurring in distinct beds, often form irregular masses and regular veins, intersecting the schistose members of the group. Here, as in the two groups of rocks already described in this paper, these crystalline rocks, as they approach their limits, gradually assume a schistose structure. Not only does the greenstone, in this way, change into hornblende slate or greenstone slate, and the granite become gneissoid, but the greenstone is found even to graduate into mica schist and clay slate. The more purely granular the greenstones are, the more does the form of the deposit deviate from that of a layer or bed.

Various subdivisions or zones have been distinguished in this group, which greatly differ in their general strike. The principal zone of the Dovrefjeld Mountains, seems to run E.N.E., which is also about the direction of the Dovrefjeld range. The dip varies much, but seems to be, on an average, about 45°. To judge from the direction of the dips given on the geological map, various folds occur in the strata, from their junction with the primitive gneiss, to where they graduate into fossiliferous beds.

In the country south of Trondhjem, the mountain masses of Dovrefjeld and Fillefjeld, consist principally of the micaceous, argillaceous, and chloritic schists, already referred to. They constitute as it were, the pedestal for the higher peaks of these ranges, such as the Jotunfjeld. These peaks are generally of igneous rocks. The Faastenen are, however, composed of serpentine, and Snehætten, of a peculiar sort of gneiss.

The most important mines of the district south of Trondhjem, are the copper mines of Röraas and its neighborhood, the chrome mines on the Dovrefjeld, and the nickel mines of Espedal.

The rocks around Röraas consist of micaceous slates, partly chloritic, and partly argillaceous. They graduate into glossy clay slates, and are sometimes described simply as green slates. These frequently assume the character of fahlbands, being impregnated with pyritous minerals, and weathering red. The deposits of Röraas, which have been worked since 1744, seem to partake of this nature. They form layers in the slates, varying from one to fourteen feet in thickness; the whole of which, however, by no means consists of cupreous minerals, but usually of many small pyritous beds, lying side by side; these being again divided into smaller ones, separated from each other by scales of chlorite schist. The preponderating ores are copper pyrites, and iron pyrites, which are sometimes mixed with magnetic pyrites and zinc blende; while chlorite, brown mica, quartz, garnet, actinolite, and asbestos, also accompany the metallic sulphurets. The ores, as they are delivered to the smelting houses at Röraas and Foldal, average only five per cent., and frequently are as low as three per cent. They are roasted in heaps, and then smelted to regulus in shaft furnaces; little or no flux being required. The resulting regulus is roasted repeatedly upon hearths, (stadeln) and again smelted, when black copper is obtained, which is refined on the small gahr hearth. The copper is principally sold for home consumption, but part is also sent to the Hamburg market, where it is known as "Drontheimer" copper.

The chromic iron mines of Röraas in Sundal, and in Lessöe, have been, and still are wrought with very considerable success. They all occur in serpentine, and in one year as many as 100 have been worked. Some of these are large and regular deposits, and others are of less extent. The most important of them are situated in the districts to the east of Röraas, Röhammerne, and Feragsfjeldene, and are owned and worked by the proprietors of the chromate of potash manufactory at Leren. Three different sorts of ore are produced at the mine, : No. 1, the best, which is exported to England, although its content in chromic oxide is much beneath what is usually contained in the Baltimore ore; No. 2, an inferior sort, which is worked up into bichromate of potash at Leren; No. 3 is a still poorer quality, which is stamped and washed, the products being also used in the manufacture of

bichromate. At the manufactory, the ore in fine powder is simply ignited in a reverberatory furnace, with about 30 per cent. of calcined potash, and little or no saltpetre. The resulting mixture yields, on lixiviation with water, a solution of neutral chromate of potash, which separates as a granular salt on evaporation. It is redissolved, and the solution is treated with a certain quantity of sulphuric acid, when crystallized bichromate of potash is obtained. The sulphuric acid is manufactured in the same establishment. One hundred parts of ore yield about thirty-seven of bichromate, so that the ore used must contain only about twenty per cent. of chromic oxide.

The nickel mines of Espedal, which are now abandoned, furnished an ore much of the same character as those of Ertelien in Ringerike, described in the first part of this paper. The mode of treatment was also similar.

The rocks of the two areas just described, offer, as we have seen, very considerable lithological differences. Those of the northern region do not appear to present any striking resemblances with the Canadian rocks, but the region about Trondhjem strongly resembles that of the Eastern Townships of Canada, and garees with it in the very points in which it differs from the mica schist region of Tromsen and Senjen. Among these are the predominance of clay slates, the presence of serpentines, with chromic iron, and the occurrence of ores of copper disseminated in the schists. These rocks of Eastern Canada have been traced from the line of the state of Vermont, for 140 miles north-eastward to the Chaudière River, and thence, at intervals, as far as Gaspé. As described in the Reports of the Geological Survey, they consist in great part of mica schists, passing into a gneiss, sometimes granitoid, on the one hand, and into clay slates on the other. Roofing slates are abundant in this series, and beds of steatite and chlorite slate are not uncommon. Quartzites, sometimes conglomerate, are met with, and limestones, which are very often magnesian, and weather of a reddish or brownish color from the presence of iron or manganese. They are sometimes replaced by carbonate of magnesia. Beds of serpentine are an important feature in this series; they are often mingled with limestone, dolomite or magnesite, and always impregnated with chrome and nickel. These serpentines are sometimes associated with diallage and with feldspathic rocks, which constitute varieties of diorite and diabase. These same rocks are traced southwards

in the Green Mountains, through a large part of the United States. All of them find representatives in the Norwegian group around Trondhjem, and in the Dovrefjeld.

This resemblance is still further traced in the metalliferous deposits of the two regions. In the Eastern Townships of Canada, copper sometimes occurs in the native state, in clay slate, but much more frequently in the form of yellow and variegated sulphurets, or of copper glance, disseminated in micaceous or chloritic slates, or in limestone. These deposits are of the nature of fahlbands. Those of Sutton and Ascott, especially the latter, have a strong resemblance to that of Röraas. The copper ores of this region are generally subordinate to the stratification. The short and irregular veins of quartz and bitter-spar, which traverse these copper-bearing strata, sometimes however carry rich ores of copper, occasionally with gold.

Iron schists, which consist of scaly peroxyd of iron, intermingled with various proportions of quartz and chlorite, constitute important beds of iron ore in some parts of this series, as in the townships of Brome and Sutton, where they were formerly wrought to a small extent. These schists resemble the itabirite of Brazil.

Chromic iron accompanies the serpentine in Canada, as in Norway. The deposits of this ore occurring in the townships of South Ham, Bolton, and Melbourne, greatly exceed those of Norway in richness and extent. The deposit in the first named township has been worked, producing an ore containing forty-three per cent of chromic oxide.

As far as regards the developement of the mineral resources of the group, Norway is in advance of Canada. Not only has the mining of copper and chrome ores been long established, but the manufacture of the valuable products obtainable from these, has been long and profitably pursued. The mines of Röraas are beginning to suffer from the scarcity of fuel at the great height, (2080 feet above the sea,) and the chrome mining and manufacturing has had to contend with expensive cartage, and often with high prices for potash, which is to a great extent imported from Russia. In Canada, around the mines of the Eastern Townships, the settler destroys acres of timber, the softer sorts of which he might burn to charcoal; and manufactures tons of potash, which the chrome miner might buy, and use to manufacture his ore into chromate of potash, at a rate alike profitable to producer and consumer. I am not aware of any district where greater advantages

exist. May they soon be appreciated, and taken advantage of, as they deserve.

These crystalline rocks in the Eastern Townships are regarded by the Geological Survey of Canada, as a metamorphosed portion of the Quebec group, which belongs to the inferior part of the Lower Silurian series. This view of their age coincides somewhat with that of Keilhau, relative to the similar formation around Trondhjem, which according to him "appears, through transitions, to stand in intimate connection with the fossiliferous Silurian strata."

In the foregoing, I have endeavoured to compare in their petrographical and economic relations, the three groups of rocks mentioned at the commencement of this paper. It was not originally my intention to pursue the subject farther than this; but seeing that the comparison which I have endeavoured to institute would be incomplete without some reference to the mutual geological relations of these groups in Norway, I offer the following remarks before concluding.

The oldest of these groups is the Primitive Gneiss formation. This at least was the opinion of the older geologists, such as Naumann, Keilhau and others, who specially studied the saviour Scandinavian formations, but Kjerulf and Dahll, to whose researches I have yet to refer, have lately declared themselves opposed to this view. According to Keilhau, the gneiss formation of Kongsberg and of Flesberg, is, to the east of these districts, conformably overlaid by the Tellemarken quartzose group, into the rocks of which the gneiss forms a gradual transition. The same relations are described by Keilhau, as occurring at other points of junction, and he concludes that the Tellemarken quartzose group is to be regarded as filling up a very broad depression in the underlying gneiss formation. The quartzose group is not found in contact with any of the schistose series described, but the analogous quartzose group of Alten and Quænanger is overlaid conformably by the mica schist rocks of Tromsen and Senjen. The relations of the latter to the Dovrefjeld slates are unknown, for wherever the last mentioned come in contact with strata belonging to the primitive gneiss formation, both the quartzose and mica schist groups are absent, and the slates of Dovrejeld rest conformably on the gneissoid strata. On the other hand, these Dovrefjeld slates form a continuous transition, through less and less crystalline slates, greywacke slates, and

sandstones, into the fossiliferous Silurian strata of the district north of Mjösen Lake. It seems therefore that the succession of these groups, in the order of their antiquity, is as follows :—

1. Primitive Gneiss formation.
2. Quartzose group.
3. Micaceous group.
4. Argillaceous and chloritic group.

$\left.\right\}$ Primitive Slate formation. (2–4)

5. Greywacke slates, sandstones, and limestones.
6. Fossiliferous Silurian strata.

It is to be remarked, that besides these stratified groups, various eruptive formations occur, whose age or place in the above list it is difficult to determine. Among these, the gneiss-granite of Vestfjord, and the granite and gneiss-granite in the southern parts of Bratsbergs Amt are the most important. The relations of the latter to the Tellemarken quartzose group, have been minutely investigated by Dahll, and described in his paper " Om Tellemarkens Geologie." He there unequivocally establishes the following succession, commencing with the more modern formations.

1. Syenite with associated granite, rhomboidal porphyry and augite porphyry.
2. The Devonian formation.
3. The Silurian formation.
4. Gneiss-granite and granite.
5. The slate formations of Tellemarken.

The relations of the latter formation to the primitive gneiss are not touched upon in Dahll's paper ; but in another " Om Kongsbergs Erts District," by Kjerulf and Dahll, it is asserted that the gneiss and mica schist of Kongsberg, or as they are called, the Kongsberg slates, " are exactly the same as those which in a more unchanged condition, are spread over large areas in Tellemarken," but separated from these by a band of eruptive gneiss-granite. The primitive gneiss formation is declared to have no existence, but to be resolvable into gneiss-granite, which is eruptive, and into slates, whose two principal types are quartz slate and hornblende slate. It is even said that gneiss " as a petrographical term, in its older and more extended meaning, is no longer advantageous to science, but the opposite." The order of succession in these older groups, according to Kjerulf and Dahll, is as follows, commencing with the oldest :

1. Tellemarken slates.
2. Granite and gneiss-granite. (Eruptive.)

3. Œsterdal slates (which are the same as the Dovrefjeld slates.)
4. Silurian formation.
5. Devonian formation.
6. Younger granite, syenite, &c. (Eruptive.)

That the extreme opinions entertained by Kjernlf and Dahll as to the gneiss formation, are capable of being substantiated, is much to be doubted. At least it seems to me that in their work above cited, nothing very conclusive is brought forward in support of their views, and moreover, no reference is made to the many well substantiated facts, upon which the older view, as to the age of the Tellemarken quartzose rocks, is founded. This total obliteration of the gneiss formation, is perhaps the most extreme point to which the supporters of ultra metamorphism have yet attained.

The views of the Canadian geologists as to the Laurentian and Huronian series are the same as those of the older geologists of Norway, where, as has been shown, these rocks are represented by the Primitive Gneiss, and by the quartzose division of the Primitive Slate formation. The Dovrefjeld slates, with their serpentines, are regarded as more recent, and as closely related to the adjacent Silurian strata. This is precisely the view of the Canadian geologists, with regard to the Quebec group, except that they include this, with its slates and serpentines, in the Silurian series, regarding it as a peculiar development of the lower part of this, and younger than the Primordial Zone. According to Sir W. E. Logan, this Quebec group was connected with a deep sea, and with movements of elevation and subsidence, the result of which is, that along the outcrop, or the shore line of the original basin, these peculiar strata are wanting. Mr. Sterry Hunt has called attention in a recent paper in this Journal, to the fact that a similar condition of things to that of Canada, seems traceable across the ocean, into Scotland, and probably as far as Scandinavia. In the Scottish Highlands, we find a schistose series, having the lithological characters of the Quebec group and the Dovrefjeld slates. This series has been the subject of much controversy. As in Norway, some have maintained that these strata are older than the lowest Silurian rocks, but Sir Roderick Murchison, with Ramsay and Harkness, seems to have shown that they are really younger than the oldest fossiliferous rocks of Scotland, and that the condition of things described by the Canadian geologists in Eastern Canada, extends across the Atlantic. Can. Nat. Vol. VI, 93.

Thus is it not only in Canada, that the position of the rocks of the schistose group is equivocal. Different views prevail as to their age in different countries. In Cornwall, they are considered Devonian, in Scotland, Lower Silurian, and in Bohemia, as in Norway, Pre-Silurian. In Belgium, Rhenish Prussia, Westphalia and Nassau, they are by some geologists regarded as Devonian, and by others as belonging to an older formation. In East Russia, on the western slope of the Ural Mountains, they are supposed to represent metamorphic Lower Silurian strata. A dissimilarity of views will probably continue to prevail as to the position of these rocks, until the question is decided, as to what value, in the absence of fossil remains, the petrographical characters of a group, taken in connection with its stratigraphical position, should have in determining its age. Perhaps there prevails at present, too much of a tendency to attribute extraordinary influences to metamorphic agencies. So soon as the true limits and effects of metamorphism are recognized, it will probably be acknowledged that, whatever view may be entertained as to their origin, the schistose rocks above referred to, underlie the Silurian, and all unaltered or metamorphosed fossiliferous strata. Following close upon more moderate views as to metamorphism, will probably come the recognition of Werner's old rule, as to the succession of these older rocks; namely that the gneiss groups generally underlie those in which mica schist preponderates, and that the latter are overlaid by argillaceous and chloritic groups. Thus the ground will be cleared for an impartial investigation into the origin of the primitive formations.

Acton Vale, Canada East, 8th April, 1862.

ARTICLE XVII.—*On the Mammals and Birds of the District, of Montreal.* By Archibald Hall, M.D., L.R.C.S.E.

(*Continued from page* 78.)

Ord. II. Passerinæ.

Fam I. Dentirostres.—Genus Lanius.

Gen. char. Bill long, compressed, toothed on the upper mandible, and much bent; tip of the lower one suberect, and not notched; nostrils concealed by nuchal bristles; cere wanting; nostrals subrotund, half closed by a membrane. 3rd and 4th primaries longest.

L. excubitor. Great American Shrike or butcher bird.
L. septentrionalis. Gmelin! Buonaparte!
Collyrio borealis? Buonaparte! Baird!

V.S.P. Bill horn colour; claws black; irides hazel; eggs 6, cinereous white, mottled and streaked at their large end with rufous.

Dorsal aspect. Crown, nape of neck, interscapular region, and scapulars, drab slate colour, or French white; auriculars black, as also the streak in front and behind the orbits and the nuchal bristles; above and below the orbits a narrow streak of white; small wing coverts light brown, scapulars tipped with white; greater wing coverts black, tipped with brownish white; rump white; tail coverts white, with distal halves of the dorsal tint; tail cuneiform, two central feathers black, two next tipped with white; the white predominates in the others as far as the outer or lateral feathers, the outer vanes of which are wholly white, the inner vanes half white, the quill half being black; quills of the primaries white—the remainder black, with minute brown white tips; secondaries black, tipped with white.

Ventral aspect. Dirty brownish white, intersected by linear zigzag lines of slate brown; vent, tail and wing coverts white; primaries and secondaries slate colour; tail black, verging to slate, except the white of the upper surface, already mentioned, which apears more conspicuous on the ventral aspect.

4th primary longest; 3rd a little shorter; tarsi black, slender; middle toe a little longer than hind toe; claw of hind toe longest and stoutest, all of them grooved; inner edge of talon of middle toe slightly salient. Length 10 inches; alar expanse about 14 inches.

Genus Muscicapa.

Gen. char. Bill moderately large, subtriangular, depressed at the base, and compressed towards the tip which is deflected, both mandibles emarginate; nostrils basal, suboval, and partly concealed by nuchal bristles; tarsus as long as the middle toe; 4th primary longest; external and middle toes basi connected; outer toe not versatile.

M. tyrannus. Tyrant Fly-catcher.
Tyrannus Carolinensis? Baird.

V.S.P. Bill, tarsi, and claws black; irides hazel. Eggs 5, yellowish-white, blotched with brown.

Dorsal aspect. Eyelids white; auriculars black; forehead, sides of the crown, and nape of neck black, the quill end of the feathers grey; crown orange red or scarlet, tipped with black, forming a crest erectile at pleasure. Scapulars, interscapulary region and rump, brown, with occasional greyish-white tips to the feathers, especially on the back. Primaries and secondaries pure brown, with their outer vanes edged with white; greater and smaller wing coverts brown, edged with white; tail coverts black, tipped with white; tail subrotund, of 12 feathers, black, with a broad terminal band of white on the central feathers; the lateral feathers minutely edged with white.

Ventral aspect. White, except on breast, sides, and flanks, which are slate colour; wing coverts slate colour, shaded to white towards the edges and tips; tail coverts white; wings slate brown; tail blackish-brown.

2nd primary longest; 1st and 4th subequal; toes and tarsi of equal length; middle toe longest; two outer toes equal; talons short, a salient inner ridge to the middle one. Length 8¼ inches; alar expanse 13 inches. Female and young resemble the male in every respect except in the scarlet crest, which is wanting.

M. Crinata. Great crested Fly-catcher.

V.S.P. Bill brownish externally, yellow internally; claws and tarsi black; irides hazel; eggs 4, dull white, blotched and mottled with purple.

Dorsal aspect. Coronal crest brown; feathers acuminate, erectile at will; nape of neck, scapulars, and dorsal region, olive brown; greater and smaller wing coverts clove brown, tipped with dull white; primaries and secondaries clove brown, inclining to bright rufous on the outer vanes of the former, and to white on the outer vanes of the latter, with a paler rufous tinge on the inner vanes of both. Tail of 12 feathers, square, the 2 centre feathers clove brown, all the others clove brown on the outer vanes, and bright rufous on the inner vanes.

Ventral aspect. Chin, throat, and auriculars bluish-grey, shaded on the breast into bright sulphur yellow, which clothes the breast, belly, vent, and tail and wing coverts. The bluish-grey of the breast is continued along the sides as far as the flank, becoming in its course blended with the sulphur yellow.

2nd and 3rd primaries subequal; 1st and 5th equal. The bill of this bird is about 1⅕ inch long from the angle of the mouth to

the apex, and about 7 lines broad at the angles. The tooth is situated close to the apex, and not well defined. The curve commences immediately above it. There is a slight emargination at the apex of the lower jaw correspondent with the tooth of the upper one. Nostrils subrotund, imperfectly concealed by the nuchal hairs; and between the orbit and the nostrils a few white mottlings on the feathers are occasionally seen. Length 9 inches; alar breadth about 13 inches. The female has the same tints as the male but less bright.

Genus Muscipeta.

Gen. char. Bill large, broader than deep, ridged above, much depressed; upper mandible notched and hooked; hook short; base set with strong nuchal bristles, which imperfectly conceal a round nostril; side toes unequal; external toe longer than the internal, and united to the middle one; 3rd and 4th primaries longest.

M. nunceola. Phæbe Flycatcher or Peewit.
M. atra of Gmelin!
M. phœbe of Latham!
M. fusca of Buonaparte!
Sayornis fuscus. Gmel.! Baird!

V.S.P. Bill, tarsi, and claws black; irides hazel; eggs 5, pure white.

Dorsal aspect. Dark olive brown, tips of wing coverts brown, secondaries edged with brownish-white on their outer vanes; tail square, brown, outer vane of the last feather minutely edged with white.

Ventral aspect. Yellowish-white, except the sides of the breast which are of the dorsal tint.

3rd primary longest; 2nd and 4th subequal; 1st and 6th subequal. Length 6 inches; alar expanse about 9 inches. The crown feathers of this bird, as well as of the birds of this genus, form a crest which is erectile at pleasure.

M. virens. Wood Pewee.
M. rapax of Wilson.

D.C. "Bill, tarsi, and claws black; irides hazel; eggs 3 to 4, yellowish-white, spotted and blotched with lilac and dark brown. Whole dorsal aspect brownish-olive, verging to blackish on the head. Ventral aspect, pale yellowish almost inclining to white; tail subfurcate; 2nd primary longest. Length 6 inches; alar breadth 10 inches." (Nuttall).

M. querula. Small Pewee.

V.S.P. Bill blackish-brown; tarsi and claws black; eggs 5, white; irides hazel.

Dorsal aspect. Dull olive green, darker on the head; primaries and secondaries brown, the latter edged with brownish-white; orbit surrounded by a ring of the same colour. Tail square, of same colour as the wings, with a minute edging of white on the outer vane of the lateral feathers.

Ventral aspect. Pale yellowish-white verging to an olive brown on the sides of the breast; inner wing and tail coverts pale yellow. 3rd primary longest; 2nd subequal to 4th; and 1st to the 6th. Length 6 inches; alar breadth 9½ inches. I feel utterly unable to identify this species with the catologue list of Mr. Baird.

Genus Setophaga.

Gen. char. Bill depressed, with nuchal bristles; both mandibles of equal length and acute, upper one scarcely notched, scarcely bent at tip, and scarcely inflected on the lower; 2nd and 3rd primaries subequal; tail long and subcuneiform. The birds of this genus are included under the sub gen. Saxicola of Genus Motacilla of Cuvier. They appear, however, to deserve a separate generic position by themselves, being intermediate between the Muscipetal and Sylvian tribes, possessing the depressed inflected bill of the former, and the long tail and tarsi of the latter, being more musical than the former, in fact emulating the latter in point of vocal capacity.

S. ruticilla. American Redstart.
Muscicapa ruticilla, of Linnæus and Wilson !!
Ruticilla minor Americana of Edwards !
Setophagus ruticilla. Baird !

V.S.P. Bill, tarsi, claws and irides black; eggs 3 to 4, cream white mottled with yellowish-brown.

Dorsal aspect. Crown of head, nape of neck, dorsal region, rump and scapulars deep black; tail of 12 feathers, long, round, four centre ones black, the others orange, with thin distal halves black; primaries and secondaries, except the outer web of the 1st, and the three or four last secondaries orange at their insertion, and the remainder black, the orange gradually increasing in breadth and depth of tint as far as the secondaries.

Ventral aspect. Throat, chest, and front of the belly black; sides of the chest, and wing coverts bright orange; lower part of

the belly, and vent and tail coverts white; wings pale orange except the distal ends which verge to slate colour.

2nd primary longest; 3rd scarcely a line shorter, and 1st a little shorter than 3rd; tarsus much longer than the middle toe slender; toes slender; claws slender, compressed; outer toe connected to inner one at the base. Length about 5 inches; alar breadth about 7 inches. The female has the tints paler, and the orange changes to a yellow. The young birds thus far resemble the female, but in exception they are deficient in the orange tint of the wings, and are paler in other respects.

S. Buonapartii. Buonaparte's Gnat-catcher.

V.S.P. Upper mandible blackish-brown; lower one pale at base edged with blackish brown; tarsi, toes and nails pale; eggs unknown.

Dorsal aspect. Greyish-ash except the crown, the feathers of which are black minutely tipped with grey, and the interscapular space which is faintly olive green. A yellow streak from the nostrils invests the eye, and a black streak from the angle of the mouth proceeds below the eye to the shoulders, where it appears to commence the zone of black spots which cross the chest like a necklace; auriculars grey; primaries and secondaries with the tail pale brown. The two former paler on the inner vanes and edged with white towards the quills.

Ventral aspect. Bright gamboge yellow, only interrupted by a zone of black spots across the chest. These spots are caused by the feathers in that place being tipped with black. Tail and wing coverts whitish.

3rd primary longest; 2nd and 4th subequal; 1st shorter than the 4th, but longer than 5th. Length $4\frac{3}{4}$ inches; alar expanse 8 inches. This bird is rarely met with. The specimen from which the foregoing description is taken, was killed at St. Remi in the spring of 1858. Is their sufficient difference between this bird and the *Sylvia pardalina*, to constitute two species of different genera?

Genus Vireo.

Gen. char. Bill short, moderately compressed, curved at the base, with nuchal bristles; upper mandible curved at the extremity, slightly notched, resembling in this respect the Muscipeta, but differing from the latter in being more compressed, and not at all depressed, in consequence of which it is deeper than broad; lower mandible a little shorter than the upper, and recurved slightly at

the tip; tongue cartilaginous and bifid; 2nd and 3rd primaries longest; outer toes connected at the base. Prevailing dorsal tint olivaceous green, whence the familiar appellation "Greenlet."

V. flavifrons. Yellow-throated Greenlet.
V. (*Lanivireo*,) flavifrons. Baird!

V.S.P. Bill, tarsi, and feet greyish-blue; irides hazel; eggs 4, white, mottled with light and dark brown at the larger ends.

Dorsal aspect. Crown, and nape of neck olive; scapulars and dorsal region dark ash colour almost slate; greater and smaller coverts edged and tipped with white on the outer vanes, causing an appearance of two bars of that colour; primaries and secondaries clove brown, edged with olive which verges to white on the outer vanes, and tipped with white on the inner vanes of all except the three last secondaries; tail of 12 feathers, round, clove brown, with the three outer feathers edged with white on both sides, and the centre feathers invariably edged with brownish-white on their outer vanes.

Ventral aspect. A yellow streak round the orbits, intersected anteriorly by a streak of dark olive passing from the base of the bill; chin, throat, and upper part of the breast, bright yellow, almost king's yellow, changing to olive on the sides of the breast, and below the shoulders, and assuming an ashy tint on the flanks; belly, vent, wing and tail coverts white.

2nd and 3rd primaries subequal and longest; 1st and 4th subequal. Length 5½ inches; alar breadth 9 inches.

V. olivaceus. Red-eyed Greenlet.
Muscicapa olivacea of Wilson!
M. altiloqua of Viellot!
Vireo (*vireosylvea*) *olivaceus.* Linn.! Viel.! Baird!

V.S.P. Upper mandibles blackish-brown; lower one pale; claws pale with a black lateral streak; middle one with a salient inner ridge, all of them much compressed; irides red in the adult, hazel in the young birds; eggs 3 to 4, white, mottled with light and dark brown.

Dorsal aspect. Crown of head ash colour, with a lateral margin over the eyes of a darker tint, a streak of white above the eye, and a faint streak of grey from the angle of the mouth to the auriculars; neck, back, rump, and scapulars olivaceous green; primaries, secondaries, and tail light brown, with their outer vanes edged with olive green and their inner ones with white.

Ventral aspect. White with an inclination to pale yellow on the sides; wing and tail coverts white tinged with yellow.

2nd primary longest. Length $5\frac{3}{4}$ inches; alar breadth 8 inches.

V. gilvus. Warbling Greenlet.
Muscicapa melodia of Wilson!
M. gilva of Viellot!
Vireo gilvus. Viel.! Buon.! Baird!

D.C. "Length 5 inches; above pale olive green much mixed with ash on the neck and shoulders; line over the eye and lower parts whitish; near the breast and sides, and under the wings tinged with pale greenish-yellow; wings greyish-brown, edged with pale olive green inclining to grey; tail similarly edged and slightly forked; legs, feet and bill above lead colour; the lower mandible pale flesh colour; iris dark hazel. The sexes nearly alike." (Nuttall).

Genus Sylvia.

Gen. char. Bill subulate, straight, slender, deeper than broad at the base; upper mandible frequently notched; lower one straight; nostrils lateral, suboval; tarsus longer than the middle toe; bastard wing short or wanting; 2nd and 3rd primaries usually longest and subequal; scapulars and wing coverts short.

S. citrinella. Summer Warbler.—Yellow-bird.
Dendroica æstiva. Baird!

V.S.P. Bill bluish; tarsi and feet pale; claws horn colour; irides hazel; eggs 4, dull white mottled with brown.

Dorsal aspect. Crown gamboge yellow; nape of neck, interscapulary region, and rump olivaceous green; wing coverts, primaries, secondaries, and tail clove brown edged with yellow. The two central tail feathers have a minute yellow edging. The others nearly altogether yellow except a clove brown streak along each side of the shafts, which widens as it approaches the tips.

Ventral aspect. Light gamboge yellow streaked with rufous orange.

Bastard wing wanting; 1st, 2nd, and 3rd primaries subequal, if anything the second longest. Length $5\frac{1}{4}$ inches; alar breadth $7\frac{1}{2}$ inches. One of our most common songsters.

S. varia. Black and White Warbler.
Certhia maculata of Wilson!
Mniotilla varia. Baird!

V.S.P. Bill black above, pale below; upper mandible slightly

curved and compressed towards the apex; tarsus not much longer than the middle toe; irides black; eggs 5, whitish mottled with brown.

Dorsal aspect. A white streak bordered by a black one, and this by a white one immediately above the eye, proceeding from the base of the bill, traverses the crown of the head and nape of the neck, and is lost upon the shoulders. A black streak from the angle of the mouth proceeds below the eye and includes the auriculars. This is separated by a white line on the throat from its fellow. Dorsal feathers black streaked with white; tail coverts, and greater and smaller wing coverts black, with white edging and tips on the outer vanes; primaries and secondaries clove brown, with white edgings to the inner vanes of all, and slate coloured edgings to the outer vanes, except on the 1st primary and two last secondaries; the former of which is minutely, and the latter broadly edged with white; tail feathers clove brown; the two outer ones with broad white tips on the outer vane, the rest, except the centre ones, edged with white on the inner vanes, and slate white on the outer vanes. The two centre feathers clove brown, with slate white edgings; tail subfurcate.

Ventral aspect. Chin and throat black, all the rest white with black streaks.

2nd primary longest; 1st and 3rd equal. Length $4\frac{3}{4}$ inches; alar breadth 8 inches. The female has the crown wholly black; primaries edged with olive, and less yellow; the throat, as also in the young bird greyish; bastard wings rudimentary.

S. coronata. Yellow-crowned Warbler.—Myrtle-bird.

Dendroica coronata. Baird!

V.S.P. Bill, tarsi and toes black; irides hazel; eggs unknown.

Dorsal aspect. Crown of head, and rump bright orange-yellow; forehead black, all the other parts slate colour spotted with black, the spots most conspicuous in the interscapulary region, and least so on the nape of the neck; they are subtriangular; greater and smaller wing coverts brownish black, edged with slate and tipped with white; primaries and secondaries clove brown, edged with brownish-white; tail subfurcate, clove brown, edged with brownish-white, and with a large white spot on the distal end of the inner vanes of the three outer feathers.

Ventral aspect. Chin, belly, vent, and tail coverts black; breast black, with white tips; sides of the breast king's yellow; wing coverts slate; flank feathers streaked with black. A black

line from the angle of the mouth proceeds backwards and includes the auriculars.

2nd primary longest; 1st and 3rd equal. Length 5½ inches; alar expanse 8½ inches. Winter plumage brownish-olive, with scarcely any black, and the yellow much fainter. The young bird much resembles the old in its winter plumage.

S. Pennsylvannica. Chesnut-sided Warbler.
S. icterocephala of Latham and Audubon !!
Dendroica Pennsylvannica. Baird !

V.S.P. Bill, tarsi, and toes black; irides deep hazel; eggs unknown.

Dorsal aspect. Crown of the head yellow with an olivaceous tinge; dorsal feathers and scapulars black, tipped and edged with olive yellow; greater and smaller wing coverts black, broadly tipped with white tinged with yellow; primaries clove brown, edged with white on the outer and inner vanes; secondaries edged with yellow on the outer vanes, and with white on the inner vanes, and tipped with the same colour; tail subfurcate, clove brown, the three outer feathers have the distal ends of the inner vanes white, the edges of the other feathers minutely and faintly white.

Ventral aspect. A black streak from the angle of the mouth passes above the eye and meets its fellow behind the yellow crown. From the same point another passes downwards and backwards, and terminates at the commencement of the chesnut band; chin, breast, belly, vent, tail and wing coverts white; sides of throat, the breast, and flanks, bright chesnut red.

2nd and 3rd primaries equal and longest; 1st and 4th equal. Length 4½ inches; alar breadth 7¾ inches. The female has the crown and chesnut sides paler, and the young birds resemble her. She also wants the black spot below the eye.

S. maculosa. Spotted Warbler.
S. magnolea of Wilson !
Dendroica maculosa. Baird !

V.S.P. Bill black; tarsi and toes brown; claws horn colour; irides deep hazel; eggs unknown.

Dorsal aspect. Crown, and nape of the neck ashy blue; interscapular region black with yellow tips to the feathers; rump yellow; tail coverts black; scapulars black edged yellow; greater and smaller wing coverts black, with broad white tips and narrow edgings; primaries and secondaries clove brown edged with white,

the white minute on the outer vanes and tinged with brown ; tail, all the feathers, except the two centre ones, have a single broad bar of white on the centre of their inner vanes.

Ventral aspect. A white streak passes from the nostril, surrounds the eye, separates the ashy blue crown and nape of neck from the black auriculars, and loses itself on the shoulders ; whole lower aspect gamboge yellow, streaked with black along the breast, sides and flanks ; tail and wings, with vent, white.

2nd primary longest ; 3rd a little longer than 1st. Length $4\frac{1}{3}$ inches ; alar breadth 7 inches. The female has the breast whitish and the colours duller.

S. pardalina. Canada Warbler.
Muscicapa Canadensis of Wilson.
Myiodioctes Canadensis. Baird !

V.S.P. Upper mandible brown ; lower one pale ; tarsi, toes, and claws pale ; eggs unknown.

Dorsal aspect. Crown black ; nape of neck, interscapulary regions, scapulars, greater and smaller wing coverts, and tail coverts ashy, with an olivaceous tinge in the interscapular space ; wings and tail brown, with a minute brownish white edging on the outer vanes of the feathers of the former.

Ventral aspect. Eyelids yellow. A white streak from the angle of the mouth, proceeds backwards below the eye, and including the auriculars, terminates on the sides of the neck. All the inferior surfaces gamboge yellow, with a broad belt of black spots across the breast ; wing and tail coverts white.

2nd primary longest. Length $5\frac{1}{3}$ inches ; alar breadth, $8\frac{1}{4}$ inches. Does this bird differ in any material respect from the *Setophaga Buonapartii ?*

S. Philadelphica. Mourning Warbler.
Geothlypsis Philadelphica. Baird !

V.S.P. Upper mandible black with pale edges ; lower one, tarsi, claws, and toes pale flesh colour ; eggs unknown.

Dorsal aspect. Head and neck lead colour, darker on the crown of the head, and terminating on the breast in a crescent of black feathers, tipped with greyish white ; dorsal region, scapulars, greater and smaller wing coverts, tail coverts and tail olive green, the vanes of the last inclining to brown ; primaries and secondaries light brown, with olivaceous green edgings on the outer vane of each feather, except the 1st on which it is white.

Ventral aspect. Lower part of breast, belly, vent, inner tail and

wing coverts, light king's yellow, changing to olivaceous on the flanks.

3rd primary rather longest; 2nd and 3rd subequal. In some cases the 2nd is a little shorter than 3rd, and 1st than 2nd. The female resembles the male in every respect, except that the plumage is duller. Length 5 inches; expanse 8½ inches.

S. Blackburniæ. Blackburn's Warbler.
Dendroica Blackburniæ. Baird!

V.S.P. Bill, tarsi, toes, and claws black; irides black; eggs unknown.

Dorsal aspect. Crown of head and nape of neck black, the former intersected by a stripe of bright orange, and bounded as well as the latter by a stripe of the same colour, which commences at the nostrils and passes over the eye; dorsal region black, interspersed with a few streaks of brownish-white; tail coverts black, margined with brownish white; tail square, black. The inner vanes of nearly all the lateral feathers white except towards the tips; outer vanes margined with brownish-white; small wing coverts black; greater ones black with white tips to the outer vanes; coverts of the secondaries or scapulars all white. Brownish-white margins on the outer vanes of the quill feathers.

Ventral aspect. An orange spot below the eye; auriculars black, bounded by orange; chin and throat bright orange, bounded by black spots becoming more numerous on the belly and flanks; breast yellow, dull, fading to white on vent and tail feathers, numerously interspersed with black streaks except in the two last positions.

1st primary longest, then the 2nd, and then the 3rd. Length 4¾ inches; alar expanse 8 inches. According to Nuttall the three lateral feathers only have white on their inner webs. In the specimens which I have seen, some five or six, it existed on the inner vanes of all except the two central feathers. This bird is one of the most pretty of the Sylvian genus. On the Island of Montreal it is not plentiful, but is found much more numerously in the groves of St. Remi on the south side of the river.

S. virens. Black-throated Green Warbler.
Dendroica virens. Baird!

V.S.P. Bill, legs, and feet black; irides black; eggs 4, flesh colour, mottled with purple and brown.

Dorsal aspect. Front yellow; crown, nape of neck, and dor-

sal region yellowish-green; tail coverts and scapulars grey with yellowish-green tips; greater and smaller wing coverts black with white outer margins and tips; quill feathers blackish-brown with brownish white margins on the outer vanes, and white on half their inner vanes; tail feathers brownish-black with brownish-white emarginations on the outer vanes, and white spots on the inner vanes of the 3 outer lateral ones.

Ventral aspect. Line over the eye, sides of the neck, and auriculars gamboge yellow; chin and throat black; breast and belly whitish with black spots, most numerous on the sides; inner wing and tail coverts white.

1st and 2nd primaries subequal and longest; 3rd about a line shorter than the 2nd; 4th a line shorter than the 3rd; and 5th about 2 lines shorter than 3rd. Length 5 inches; alar breadth 8 inches. The female is said to have the "chin yellow, and the throat blackish tinged with yellow."

S. striata. Black Poll Warbler.
Dendroica striata. Baird!

V.S.P. Upper mandible black; lower one and legs pale flesh; irides hazel; eggs 4 to 5, whitish mottled with brown.

Dorsal aspect. Crown and nape of neck deep black, bordered by greyish white; interscapular region, back and rump black, the feathers margined with grey; greater and smaller wing coverts tipped with white, causing an appearance of two white bands on the wing; primaries and secondaries brown, the former with the outer vanes edged with greenish-olive, the latter with greenish-white. Two lateral tail feathers with white spots towards the extremities of their inner vanes.

Ventral aspect. Auriculars and cheeks white; throat, breast, belly, and vent white, margined by a continuous line of black spots or streaks, commencing at the brown mandible, and ending on the flanks, and becoming gradually broader and larger from the throat downwards; inner tail coverts white.

1st primary longest. Length 5 inches; alar breadth 9 inches. "Female and young dull yellow olive, streaked with black and grey; breast white; cheeks and sides of the breast tinged with yellow."

S. castanea. Bay-breasted Warbler.
Dendroica castanea. Baird!

V.S.P. Bill black; legs and feet pale; irides deep hazel; eggs unknown.

Dorsal aspect. Forehead and cheeks black, including the eyes and the auriculars; behind the auriculars a spot of buffy white; crown of head bright bay; scapulars, dorsal region and rump brownish-black, with broad margins and tips of olivaceous yellow; greater and smaller wing coverts black, tipped with white, causing an appearance of two white bands; primaries, secondaries, and tail feathers brown, the three lateral tail feathers with white spots on the inner webs near their tips.

Ventral aspect. Chin, throat, breast, and sides, bay; belly, tail, inner tail and wing coverts white, tinged with yellow.

2nd primary longest; 1st and 3rd equal. Length $4\frac{3}{4}$ inches; alar breadth $7\frac{1}{2}$ inches. The female has a paler bay on the breast, and less black on the head.

S. pinus. Pine Warbler.
Dendroica pinus. Baird!

V.S.P. Bill and feet brown; irides hazel; eggs 4, greenish-white, mottled with pale brown and slight purple.

Dorsal aspect. Olive brown interspersed with streaks of a darker hue; tail coverts olive yellow; primaries and secondaries edged with brownish-olive, narrowly on the 1st primary, rather broadly on the 2nd; the tips of all having a whitish worn appearance. A yellow line, from the nostrils over the eye, terminates over the auriculars which are of the dorsal colour.

Ventral aspect. Faint gamboge yellow, interrupted on the breast by olive brown streaks, which are continued along the flanks; tail coverts bright yellow; tail clove brown, outer vanes edged with olive yellow; inner vanes of the two lateral ones white towards their tips.

2nd primary longest; 1st, 3rd and 4th, subequal. Length $4\frac{3}{4}$ inches; alar breadth $7\frac{1}{2}$ inches. According to Nuttall,—"The male is bright olive yellow tinged with green, beneath yellow with obscure spots; vent white; wings with two white bands, and with the tail dusky brown; two lateral tail feathers partly white; lores not black." My description is taken from a female.

Sylvia rubricapilla. Nashville Warbler.
Helminthophaga ruficapilla. Baird!

V.S.M. Bill horn colour, pale beneath at the base; irides dark; legs and feet pale; eggs unknown.

Dorsal aspect. Crown dark chesnut; frontlet, sides of head, lores and occiput, ashy, tinted in the latter situation on the male

with olive yellow. Line from the nostrils to eye yellowish-white; line encircling the eye white; interscapulary region, scapulars, rump, tail and wing coverts olive yellow, brightest on the rump and back: quill feathers and tail dusky, edged on the outer vanes with yellow olive.

Ventral aspect. Chin, throat, breast, flanks, and tail coverts king's yellow, diluted with ash on flanks; belly and vent white; upper femorals white, tinged with ash, brown or yellow. Very rare.

Length about $4\frac{1}{2}$ inches; alar expanse, 7 inches. There is very little difference between the male and female. The feathers on the occiput in the specimen before me are destitute of the olive yellow tint, and the line from the nostrils to the eye is white. The yellow in the ventral aspect is equally as bright as in the male. She has in contradistinction to the observation of Mr. Nuttall the bright chesnut crown, which is however scarcely so large as in the female. A pair of these birds was shot by Sir W. Logan in this vicinity, in the year 1841, from which this description is taken.

Sylvia Canadensis. Black-throated Blue.
Dendroica Canadensis. Baird!

V.S.M. Bill black; legs and feet dusky; irides dark; eggs unknown.

Dorsal aspect. Head, interscapulary region, wing and tail coverts slate blue; quill feathers of wing and tail clove brown; all the primaries except the first, and the two outer tail feathers with a white streak, which on the latter is situated on the inner vanes; outer edges of vanes of primaries and secondaries edged with olive green; of the tail with slate blue.

Ventral aspect. Cheeks, throat, and flanks below the wings, deep black; breast, belly, inner wing, and tail coverts white.

3rd primary longest; 2nd and 4th subequal; 1st shorter than 4th, but considerably longer than 5th. Length $4\frac{3}{4}$ inches; alar expanse 7 inches. A fine specimen, from which this description is taken, was shot by Sir W. E. Logan in May, 1841. I have not seen either the female or young. According to Nuttall, the black of the female inclines to dusky ash or is wanting?

The foregoing fourteen species of this numerous genus, are the only ones which it has fallen to my lot to observe in this neighbourhood. I have no doubt, however, that the district of Montreal might also furnish us with the S. Auricollis, Autumnalis,

Parus, Americana, Trochilus, Trichas, and probably Azurea. These birds are known to migrate as far North as, and in one or two cases, beyond Canada, and they *are to be* discovered in this District. As the object of this paper is not to speculate upon what might be found, but to give descriptions of what really has been found in this District, I refrain from any further remarks on this tribe at present.

Genus Regulus.

Gen. char. Bill straight, slender, deeper than broad, compressed from the base, narrowed in the middle, with somewhat incurved edges, and furnished with nuchal bristles; upper mandible slightly notched and curved at the tip; nostrils basal, oval, and half closed by a membrane; 3rd primary longest; 1st and 7th equal; tarsus longer than the middle toe; tail notched.

R. calendula. Ruby-crowned Wren.
Sylvia calendula of Wilson!
R. calendula. Baird.

V.S.P. Bill and legs brown; irides black; eggs unknown.

Dorsal aspect. Olive green, darker on the frontlet; on the posterior part of the crown an oval vermilion spot; eyelids pale yellow; tail and wing feathers clove brown, with yellow edgings on the outer vanes of the quills of the former, and primaries of the latter. Inner vanes of all, and outer vanes of the secondaries edged with white; greater and smaller wing coverts tipped with white.

Ventral aspect. Yellowish-white throughout; spureous wing feather nearly an inch long.

3rd and 4th primaries equal; 2nd and 5th equal; 1st a little shorter than the 6th, but longer than the 7th; tail subfurcate. Length 4 inches; alar breadth about 6½ inches. The female and young bird want the vermilion spot, and are otherwise more sombre.

R. cristatus. Golden-crested Wren.
Sylvia regulus of Wilson!
R. satrapa. Baird.

D.C. Bill black; legs brownish-yellow; feet and claws yellow; irides hazel; eggs 6 to 12, yellowish-white spotted with red.

Dorsal aspect. Olive yellow inclining to ash on the nape and sides of neck. A white line from the nostril, proceeds over the eyes, and terminates above the auriculars. Above this passes a broadish stripe of black, both stripes meeting on the frontlet; crown of the head rich flame colour. A black line from mandible

to the auriculars is accompanied by a white one below it; wings and tail dusky edged with yellow olive; inner vanes of the primaries and secondaries whitish; greater and smaller wing coverts tipped with white, edged in the former with brown, forming two white wing bars; tail long subfurcate. Female much more dusky and dull whitish beneath. Length 4 to 4½ inches; alar breadth 7½ to 8 inches.—(*Condensed from Nuttall.*)

Genus Troglotides.

Gen. char. Bill slender, subulate, not so much compressed as in the last, slightly curved; nostrils basal, oval, half closed by a membrane; tarsus longer than the middle toe; inner toe free; nail of the hind toe longest; wings short and rounded; 4th and 5th primaries subequal and longest.

T. fulvus. House Wren.
T. ædon of Audubon ! and Baird !
Sylvia domestica of Wilson !
Sylvia fulva of Latham !
T. ædon, Baird !

V.S.P. Upper mandible brown; lower one, legs and feet pale, inclining to yellow; eggs 10 to 18, white, with a few reddish spots.

Dorsal aspect. Brown, darkest on the head, and except on this place and the neck, barred with dusky; primaries and secondaries clove brown, the latter barred with dusky and rufous brown, the former with clove brown and white on the outer vanes only; tail cuneiform, rufous brown with 9 to 10 dusky bars, white taking the place of brown on the outer vane of the lateral feathers.

Ventral aspect. Brownish-grey, barred on the vent, flanks and tail coverts with blackish and brownish-white. A streak of the ventral colour passes from the nostril over the eye, and terminates behind the auriculars; spurious wing feathers long.

2nd 3rd, and 4th primaries subequal, if anything the 2nd longest. Length 3¾ inches; alar breadth 6 inches.

T. Europæus. Winter Wren.
T. hyemalis of Viellot !
Sylvia troglotides of Wilson !
T. (*anorthura*) *hyemalis.* Baird !

V.S.P. Upper mandible black; lower one, legs and feet pale; irides deep hazel; eggs 10 to 18, white spotted with red.

Dorsal aspect. Rufous brown, darker on head and neck, and numerously barred with dusky except in these two situations. On the sides of the neck, and among the wing coverts, a few white tips to the feathers may be seen; wings and tail like the last.

Ventral aspect. Throat and breast rufous brown, with indications of bars of a deeper tint; belly, vent, and tail feathers deep brown, barred with a lighter shade; spurious wing feathers long.

3rd and 4th primaries equal; 2nd and 5th equal; 1st and 7th equal. Dimensions same as the last.

T. Parkmanni. Parkman's Wren.
T. Parkmanni. Baird.

V.S.P. Bill, upper mandible horn colour, and slightly curved; lower one whitish underneath; irides black; tarsi brownish, coloured with seven distinct scutelæ; eggs unknown.

Dorsal aspect. Prevailing tint reddish-brown, the dorsal feathers tipped with white; tail of the same hue, rounded, composed of 12 feathers with 12 bars of dusky black, the outer vanes of the lateral ones with spots of whitish.

Ventral aspect. Prevailing tint on throat and breast greyish, with faint barrings of umber brown; abdomen greyish-white; hinder tail coverts whitish, barred with dusky black.

Length from tip of bill to extremity of tail, 4¼ inches; alar expanse 5 inches. 1st primary half the length of the second, thus giving the wing a rounded appearance. The tail is also rounded.

A specimen of this beautiful wren was shot in the vicinity of this city by Mr. Hunter, Taxidermist to the Natural History Society, during the spring of 1861. It is now a specimen in the cabinet of the Society.

Genus Anthus.

Gen. char. Bill straight, slender, subulate from beyond the nostrils; upper mandible slightly notched near the tip; nostrils half closed by a membrane, basal and lateral; hind claw longer than the toe; 4th primary and 2nd scapular equal; 2nd and 3rd primaries longest.

A. spinoletta. Brown Lark.—Shore Pepit.
A. aquaticus of Audubon!
Alauda rufa of Wilson!
A. Ludovicianus. Baird?

V.S.P. Upper mandible black; lower one pale; legs and feet

brown; irides hazel; eggs 4 to 5, sullied white, mottled with brown.

Dorsal aspect. Dark greyish-brown. Two central tail feathers with margins of a lighter hue; all the lateral feathers clove brown, except the two external ones, the last one of which has its whole outer web, and half its inner web white, and a spot of white towards the distal end of the next one; primaries and secondaries clove brown, with whitish margins to their outer webs; scapulars clove brown with worn edges; 2nd longer than 4th primary, and white on the margin of the outer vane; greater wing coverts margined and tipped with brownish-slate colour; smaller ones tipped with pure white.

Ventral aspect. A streak from the nostrils encircling the eyes, cheeks, sides of neck, and belly and vent light brownish red. On the flanks, breast, and sides of neck, streaks or spots of black; chin white, merging into the reddish-brown of the throat.

1st, 2nd, and 3rd primaries subequal and longest. Length 6½ inches; alar breadth 11 inches. The female differs from the male in being more spotted, and the young bird has an olivaceous blackish-brown dorsal tint.

Genus Ampelis.

Gen. char. Bill short, a little depressed, deeper than broad; trigonous at the base; upper mandible notched and curved at the tip; lower one straight and compressed at the sides; nostrils basal, lateral, subrotund, and half closed by a membrane; tarsus strong, a little shorter than, or as long as the middle toe; inner toe free; hind one longer than the nail; lateral toes united as far as the second joint; 2nd primary longest.

A. sialis. The Blue Robin.
Sialia Wilsonii of Swainson!
Sylvia sialis of Wilson!
Saxicola sialis of Buonaparte!
Sialia arctica
Sialia sialis. Baird!

V.S.P. Bill and legs black; irides bright hazel; eggs 5 to 6, pale blue, unspotted.

Dorsal aspect. Including the wings and tail, bright, glossy azure blue. Towards the tips and edges of the inner vanes of the primaries and secondaries there appears an inclination of the blue to a brown.

Ventral aspect. Ferruginous, deeper on the breast and paler on the throat and vent, the latter almost white; inner tail coverts whitish.

2nd primary longest; 1st and 3rd subequal, and very little shorter than 2nd. Length $6\frac{3}{4}$ inches; alar breadth 12 inches. The female is duller coloured, and the young bird is dusky, with occasional spots of white, and inferiorly whitish clouded with dusky, but the wings and tail azure blue; hind claw only $\frac{2}{3}$ the length of the tarsus including the nail; middle toe and tarsus equal.

Genus Bombycilla.

Gen. char. Head crested; bill short, straight, elevated, as deep as broad at the base; nostrils ovoid, basal, open, concealed by nuchal bristles, projecting forward; upper mandible with a strongly marked tooth, and slightly curved towards its extremity; exterior toe joined to the middle one as far as the 1st joint; 1st and 2nd primaries longest; spurious wing feathers very short; middle toe a little longer than the tarsus.

B. Carolinensis. Cedar Bird—Cherry Bird—Recollet.
Ampelis Americana of Wilson!
Ampelis cedrorum. Baird!

V.S.P. Bill, legs and feet black; eggs 4 to 5, white, spotted black towards their larger end.

Prevailing tint of the dorsal and ventral aspects, fawn, deepening in tint on the back, and changing to a yellow on the abdomen; upper tail coverts black; lower ones white; primaries and secondaries dark ash colour, with brownish-white margins to the outer vanes, and white on the inner vanes; shafts of the secondaries elongated with broad scarlet waxen tips. These tips vary in number; in the specimen before me there are seven, and in others I have seen but one or two existing, and very often none at all. Tail with a terminal broad yellow band, occasionally tipped like the secondaries; frontlet, streak to, and beyond the eye, with the chin velvet black. A white streak on the posterior half of the lower mandible, and on the posterior half of the eyelid; Crest large and conic.

2nd primary longest; 1st larger than the 3rd. Length 7 inches; alar breadth $13\frac{1}{2}$ inches. The young birds are deficient in the waxen tips, and I believe that the same ornaments are not unfrequently met with in old females.

B. garrulus. Waxen Chatterer.
Ampelis garrulus of Linnæus and Baird!

D.C. "Feet and legs black; irides reddish; eggs unknown.

"Anterior part of the head bay, passing posteriorly into a reddish drab, which is the prevailing dorsal tint, as well as of the breast; lower part of the back and rump ochreous; belly and femorals pale ash; vent reddish chesnut; quills dusky, the 1st spotless, all the others with white spots towards the tips of the outer webs; four of the secondaries with red waxen tips; feathers of the bastard wing tipped with white; tail 3 inches, black, broadly terminated with pale yellow."—(*Condensed from Nuttall.*) They are extremely rare visitants and seen chiefly during the early and latter winter months frequently accompanying the Crossbill and Grosbeak.

Genus Turdus.

Gen. char. Bill straight, compressed and curved at the apex; upper mandible notched and furnished with nuchal bristles, pointing forward; nostrils basal, lateral rounded, and half closed by a naked membrane; outer and middle toes connected at the base; 3rd, 4th and 5th primaries longest; scapulars about as long as the secondaries.

T. migratorius. The Robin.—Le Grieve.
T. (Planesticus) migratorius. Baird!

V.S.P. Upper mandible black, with yellow edgings; lower one yellow with a black tip; legs and feet dark brown; eggs 5 bluish green.

Dorsal aspect. Brown; crown of head, occiput and auriculars black; primaries, secondaries, and greater wing coverts dark brown, with edgings of a lighter hue; tail square, black; two, sometimes three of the lateral feathers with white tips.

Ventral aspect. Orbit with three marginal white spots; chin, and throat white streaked with black; breast, belly, sides, and inner wing coverts red, the feathers tipped with white; vent and tail feathers white, the latter with a single broad conical brown spot in the centre of the vanes; wing linings tinged with red.

3rd primary longest; 1st and 5th equal; scapulars half the length of the secondaries. Length 10 inches; alar breadth 16 inches. The female has duller colours.

T. rufus. Ferruginous Thrush or Thrasher.

V.S.P. Upper mandible black, not notched; lower one, legs

and feet pale flesh colour, the lower mandible black towards the tip; irides yellow; eggs 5, greenish-white speckled with brown.

Dorsal aspect. Ferruginous; greater and smaller wing coverts of same colour, succeeded by a deep brown, terminated by a white tip; primaries and secondaries ferruginous on the outer vanes, and inclining to ash on the inner ones, except the three last secondaries which are wholly ferruginous; tail 5½ inches long, cuneiform; the three lateral feathers inclining towards their tips.

Ventral aspect. White, with tear shaped spots of blackish-brown on sides of neck, breast and flanks; tail coverts ferruginous white.

4th primary longest; 2nd of same length as secondaries; 1st very short; in consequence of which relative length of these quills the wing is short and rounded. Length 11¾ inches; alar breadth 13 inches. Female scarcely differs from the male.

T. felivox. The Cat Bird.
Mimus Carolinensis. Baird!

V.S.P. Bill black, not notched; legs brown; irides deep hazel; eggs 4 to 5, emerald green.

Dorsal aspect. Slate colour; crown of the head and tail black; primaries and secondaries blackish-slate colour.

Ventral aspect. Pale slate; undertail coverts reddish-brown; tail rounded.

3rd primary longest. Length 8½ inches; alar breadth 10 inches. The female does not differ from the foregoing description. In the young bird of the year the black of the head is not developed, and the reddish-brown of the undertail coverts is paler.

T. minor. The Hermit or Little Thrush.
T. solitarius of Wilson!
Turdus pallasi? Baird!

V.S.P. Upper mandible black; lower one towards the base and the legs pale flesh; irides deep hazel; eggs 4 to 5, greenish-blue, mottled with olive.

Dorsal aspect. Olivaceous, inclining to rufous on the head, according to Nuttall—in the specimen before me, olivaceous; tail ferruginous; primaries and secondaries inclining to ferruginous on the outer webs, and ashy on inner ones.

Ventral aspect. Line round the eye white; chin, throat, and breast yellowish-white, streaked with black on the side of the

throat, and spotted with black on the breast. The spots have an olivaceous tint on the breast, and become blended together on the flanks; abdomen, vent, and tail coverts pure white; inner webs of the secondaries with an oval yellowish-white spot towards the base of their inner webs.

3rd primary longest; 1st a little longer than 5th. Length 7¼ inches; alar breadth 11 inches. Bill slightly notched.

T. mustelinus. The Little Thrush.
T. Wilsonii of Buonaparte!
T. mustelinus. Baird!

V.S.P. Bill blackish-brown, except at the base of the lower one which is pale; legs pale brown; irides deep hazel; eggs 4 to 5 emerald green.

Dorsal aspect. Brownish ferruginous; an oval spot of yellowish-white towards the base of the inner webs of the secondaries.

Ventral aspect. Line round the orbits pale; cheeks, throat, abdomen, vent and tail coverts pure white; breast, and sides of the neck cream colour spotted with brown; sides of the breast and flanks inclining to ash.

2nd primary longest; 1st and 3rd equal. Length 7 inches; alar breadth 11½ inches. Tail square, feathers pointed.

T. melodus. The Wood Thrush.
T. mustelinus of Wilson! Baird!

D.C. Above bright cinnamon brown, brightening into rufous on the head, and inclining to olive on the rump and tail. Beneath whitish, thickly marked with pencil shaped spots; vent pure white; orbits of the eye white; bill dusky brown slightly notched, the lower mandible flesh coloured towards the base; legs and claws very pale flesh colour; iris dark chocolate. Length 8 inches; alar breadth 13 inches.

(To be continued.)

ARTICLE XVIII.—*On the Extraction of Cobalt Oxide from the Iron Pyrites occurring near Brockville, C. W.* By THOMAS MACFARLANE.

About two miles to the north-west of Brockville, in the township of Elizabethtown, C. W., there exists a deposit of iron pyrites of very considerable extent and importance. It belongs to the Laurentian system, but it is not known what rocks immediately adjoin it, as they do not come to the surface. Although an excavation of fifty feet long, and thirty broad, has been made in the deposit, the limit of the minerals in either direction, has not been reached. Two varieties of the pyrites are found here, the one somewhat porous and dull, and the other compact, of a yellowish-white colour, and a very bright lustre. Iron pyrites, as is well known, contains one equivalent of iron and two of sulphur; or 45.77 per cent. of the former, and 54.23 per cent. of the latter element. It is a most important source of sulphur for the manufacture of sulphuric acid. The iron pyrites of the above mentioned locality contains the usual constituents, but in the compact variety especially, a portion of the iron is replaced by a small per centage of cobalt, equal, according to Dr. Hunt's analysis, to 0.52 per cent. of cobalt oxide, and according to my own to 0.50 per cent. The occurrence of cobalt in many pyrites of the Laurentian formation, has been repeatedly remarked by Dr. Hunt, and I have detected its presence in many specimens of pyrites occurring in the Primitive Gneiss formation in Norway. While at the Modum Smalt works, and the Skuterud cobalt mines in that country, I had opportunities of experimenting on these pyrites, and of devising a process for economically extracting the cobalt which they contain. The principal object of the present paper is to describe the manner in which this process might be advantageously applied in treating the Brockville pyrites.

When the compact variety of the cobaltiferous iron pyrites of the above deposit, in fine powder, is mixed with one-tenth of its weight of common salt, also finely divided, and calcined at a low red heat, with free access of air, the following chemical changes take place:—First, the greater part of the sulphur of the pyrites is oxidized, and disengaged as sulphurous acid, the iron also combining with oxygen and forming peroxide of iron. At the same time the small proportion of cobalt present is con-

verted into cobalt oxide. At a later stage of the operation, part of the sulphurous acid formed comes in contact with the peroxide of iron, and is, through its agency, further oxidized into sulphuric acid, which combines with the iron oxide, forming finally a comparatively small quantity of sulphate of peroxide of iron. The cobalt oxide also combines with sulphuric acid, forming sulphate of protoxide of cobalt. These sulphates react on the common salt, producing sulphate of soda, with perchloride of iron and protochloride of cobalt. Air having still access, the perchloride of iron is resolved into peroxide of iron and chlorine gas, which escapes and may be recognized by its odour, so soon as the evolution of sulphurous acid has ceased. Protochloride of cobalt is also decomposable by heating in a current of air, the products being chlorine and cobalt oxide; but this change does not take place until the perchloride of iron has been wholly decomposed. It is at this point that the calcination must be interrupted; that is, as soon as the perchloride of iron is decomposed, but before the decomposition of the protochloride of cobalt commences. When the operation is stopped exactly at this point, the calcined residue yields with water a solution containing no iron oxide, or but a trace, and the whole of the cobalt in the state of protochloride.

I have made many trials of the above process with the Brockville pyrites, all yielding results confirmatory of the above reactions. The following are among the most conclusive of them: 1000 grains of the ore were calcined as above described, with 100 grains of common salt in a common muffle furnace. The materials were withdrawn from the muffle, as soon as strong and pure chlorine commenced to be evolved, and the evolution of chlorine continued until the materials were cooled to a certain point. The calcined residue weighed 780 grains, and contained in 100 parts,

Peroxide of iron........	85.300.	
Sulphate of soda.... ...	5.700	= 1.28 sulphur.
Protochloride of cobalt,..	1.343	= 0.775 cobalt oxide.
Protochloride of copper..	0.327	= 0.193 cupric oxide.
Perchloride of iron......	0.059	= 0.029 ferric oxide.
Chloride of sodium......	7.271	by difference.
	100.000	

The five last mentioned constituents were of course soluble in water. According to these results, the 780 grains of residue must have contained six grains of cobalt oxide; consequently 0.60 per cent. of this substance had been extracted from the pyrites. The

1000 grains of pyrites contained 542.3 grains of sulphur, and the 780 grains of the residue, only 9.98 grains Consequently 98.16 per cent. of the sulphur had escaped as sulphurous acid, and only 1.84 per cent. had been converted into sulphuric acid and combined with soda.

That the iron oxide, as stated above, has considerable influence in converting the sulphurous acid into sulphuric acid, will appear from the following experiment: 59 grains of iron pyrites, 58½ grains of common salt, and 234 grains peroxide of iron, (free from sulphuric acid) were mixed and calcined in a muffle, at a low red heat, until sulphurous acid and chlorine ceased to be evolved. The materials weighed after calcination 336 grains, and contained in 100 parts:

Peroxide of iron......	79.5	
Sulphate of soda......	19.2	= 4.31 sulphur.
Chloride of sodium....	1.3	by difference.
	100.0	

The original 59 grains of iron pyrites used, contained 32, and the resulting 336 grains, 14.48 grains of sulphur. Consequently 55 per cent. of the sulphur had escaped as sulphurous acid,* and 45 per cent. were converted into sulphuric acid, instead of 1.84 per cent. as in the experiment above described. That the larger quantity of salt used did not materially contribute to this result, I have proved by a series of experiments, which resulted as follows:—

1. When iron pyrites, mixed with 5 per cent. of its weight of common salt, is calcined as in the last described experiment, 1.24 per cent. of the sulphur contained in it, is converted into sulphuric acid, and combined with the soda.

2. When 10 per cent. of salt is used, 1.84 per cent. of the sulphur is, as we have seen, converted into sulphuric acid.

3. With 50 per cent. of salt, 2.86 per cent. of the sulphur is retained as sulphuric acid.

4. With 100 per cent. of salt, 7.46 of the sulphur is thus retained.

In this last, the proportion of common salt to the pyrites is the same as in the experiment where peroxide of iron was used, but in the latter case five times more sulphur was converted into

* The sulphurous acid was accompanied by chlorine, in almost the proportions necessary for their complete conversion of the two into sulphuric and hydrochloric acids, on being brought into contact with steam. ($SO_2 + Cl + HO = SO_3 + HCl$).

sulphuric acid, than when the pyrites was calcined with salt alone.

Having thus explained the rationale of the process, I proceed to touch upon its application on the large scale. It will be seen from the above experiments that only a very small proportion of the sulphur contained in the pyrites, is necessary for the extraction of the cobalt. There would be abundance of it left in the pyrites for this purpose, even although it were previously roasted in pieces of about the size of an egg. It has been found that the residue from the burning of pyrites in lumps, in the manufacture of sulphuric acid, contains six or seven per cent. of sulphur,* and this would also be the case with the Brockville pyrites, if roasted in heaps or shaft furnaces. A previous roasting would be of advantage, because it would lessen the cost of the subsequent calcination, render the pyrites more easily stamped to powder, and admit of the manufacture of sulphuric acid from the sulphurous acid evolved. After roasting, the pyrites is reduced to powder, and mixed with the salt. The mixture is then brought on to the hearth of a common calcining reverberatory furnace, heated to low redness, raked about, and tested from time to time. So soon as pure chlorine is evolved, and the mass ceases to glow in the furnace, and gives with water a solution containing little or no iron, the mixture is withdrawn from the furnace. When cool, it is brought into a large tub, where it is stirred up with hot water. If the calcination has been properly performed, a solution is obtained having a beautiful rose colour. This is drawn off, or if necessary filtered from the insoluble residue of peroxide of iron which is washed with fresh quantities of water until it no longer yields a solution containing cobalt. The more dilute solutions thus obtained, are used for treating fresh quantities of the calcined material. The rose-coloured solution contains besides the cobalt, a small quantity of copper, and a trace of iron, together with whatever sulphate of soda has been formed, and the common salt which may have been left undecomposed. The copper and iron may be separated from the solution by adding a slight quantity of a dilute solution of carbonate cf soda. They are precipitated as carbonates, before the cobalt, and are separated from the solution by filtration. The filtrate is then treated with a further quantity of a solution of carbonate of soda, more con-

* Fabriques de produits chimiques. Rapport à M. le Ministre de l'Interieur, par la Commission d'enquête. Bruxelles, 1856.

centrated than before. Carbonate of oxide of cobalt falls as a peach-blossom colored precipitate. This is washed by subsidence and decantation, collected on a linen filter, dried and ignited in close vessels. The result is pure cobalt oxide, such as is used for imparting a blue colour to porcelain and stone-ware. Its price in the English market, about a year ago, was thirteen shillings sterling the pound, and probably its present value may with safety be assumed to be eleven shillings sterling.

The cost of the process above described, depends of course, much on the locality where it is carried into operation. But even supposing this to be some distance from the mine, I believe the manufacture would be found to be remunerative. The cost of both mining and manufacturing might be estimated as follows:—

Excavation, per ton.............	$3.00
Roasting "	0.25
Freight to factory, say...........	2.50
Stamping......................	0.50
Calcining.....................	6.00
Lixiviation, precipitation, &c.....	1.25
Freight to market, agency, &c....	0.50
	$14.00

From one ton of ore there might be produced, making some allowance for occasional failures, at least eight pounds of cobalt oxide, worth eleven shillings sterling the pound, equal to £4 8 0 or $21.12. I think therefore that the treatment of the Brockville pyrites for cobalt might reasonably be expected to yield a profit of, say $7 per ton. Of course, many disadvantages and failures are apt to attend the commencement of any new manufacture, but in the above estimate I have made some allowance for such.

In this calculation, I have reckoned nothing for the sulphur which the pyrites contains. Were the manufacture of sulphuric acid combined with that of the cobalt oxide, there is no doubt but that a very remunerative business might be established. Canada is certainly not a manufacturing country. It is therefore improbable that much sulphuric acid would be used here for manufacturing soda, or in bleaching or dyeing. But Canada contains inexhaustible sources of rock oil or petroleum. Owing to the offensive odour of this substance in its crude state, it is difficult to procure freight for it to Great Britain. This neces-

sitates its purification in Canada, and as is well known, sulphuric acid is the most effective deodorizer that can be employed in refining it. In proportion then as refineries for petroleum are established, the demand for sulphuric acid will increase, and no doubt a manufactory of this acid would be able to dispose of an immense quantity. There are very few chemical manufactures which may be said to be indigenous to Canada, but this one, of the products to be obtained from these pyrites, in conjunction with that of refined oils from crude petroleum, possessing a natural and sound foundation in the province, would flourish rapidly, and doubtless be permanently successful.

Acton Vale, C. E., 13th May, 1862.

ARTICLE XIX.—*List of Entomologists in Canada.* BY REV. CHARLES J. S. BETHUNE, B. A., Cobourg, C. W.

The following list of those engaged in the study of Entomology in Canada has been prepared chiefly with the object of making collectors known to each other. It is almost unnecessary to state that the idea was suggested by the lists in Stainton's Entomologists' Annuals. It was at first considered that the great and primary advantage to be derived from it was that collectors in one part of the country would be enabled by its means to find out who are addicted to their favourite pursuit in other places, and thus obtain specimens of those local species in which their own collections are deficient. Since, however, the number of those engaged in this study has proved to be so much larger than was at first anticipated, several of my correspondents have agreed with me in the opinion that it would tend very much to the advancement of Entomology in this country, were a club to be formed, and meetings to be held once or twice a year at some central place, to be decided upon hereafter. We have come to the conclusion that, if this project meets with sufficient encouragement from Entomologists, no better time or place could be selected for the first meeting than that appointed for the next exhibition of the Provincial Agricultural Association, which is to be held at Toronto, during the week commencing September 22nd, 1862. If such a meeting can be held, it is much to be desired that Entomologists should bring to it all their *undetermined* specimens, as well as any duplicates they may have of rare species; by so doing favours could be mutually conferred, and much information diffused with regard to the distribution of species, etc. The Meeting would, doubtless, prove ad-

vantageous in many other respects; and, in addition, such a *réunion* of kindred spirits could not fail to prove exceedingly agreeable. I trust, therefore, that this project may not fall to the ground, but that before long, Canadian Entomologists may have the pleasure of making each other's acquaintance.

In the following list is enumerated every Entomologist in Canada whose name and address I could learn, and who was willing to permit his name to appear; there may be a few others,—if so I trust they will speedily make themselves known either to Mr. Saunders (who has kindly shared with me the trouble of preparing this list) or to myself.

1. Beadle, D. W., St. Catherines, C. W. *Coleoptera and Lepidoptera.*
2. Bell, R., Provincial Geological Survey, Montreal. *All orders; but especially Coleoptera and Lepidoptera.*
3. Bethune, Rev. Charles J. S., B. A., Cobourg, C. W. *Coleoptera and Lepidoptera.*
4. Billings, B., Prescott, C. W. *Coleoptera, Lepidoptera, and Orthoptera.*
5. Billings, E., F.G.S. Provincial Geological Survey, Montreal. *Coleoptera and Lepidoptera.*
6. Bush, Geo., Coldwater, County of Simcoe, C. W. *Insects of all orders; collects also for sale.*
7. Clementi, Rev. Vincent, B. A., Peterboro', C. W. *Coleoptera and Lepidoptera.*
8. Cottle, Thomas, Woodstock, C. W. *Lepidoptera.*
9. Couper, William, National Bank Building, John street, Quebec. "Entered the Entomological fields of Canada in 1843, and still continues his researches. *Collects all the orders*, and studies the geographical distribution of *Coleoptera*."
10. Cowdry, Thomas, M. D., York Mills, County of York, C. W. *All orders.*
11. Cowdry, Harrington, York Mills, C. W.
12. Croft, Prof. Henry, D.C.L. University College, Toronto. *Collects all orders, but more especially Hymenoptera and Coleoptera.* His collection of Coleoptera is the finest in the Province.
13. Crooks, Miss Kate, Hamilton, C. W.
14. Cummings, Willoughby, Chippawa, C. W. *Coleoptera and Lepidoptera.*
15. Denton, J. M., Dundas Street, London, C. W. *Lepidoptera and Coleoptera.*
16. Devine, Thomas, Crown Lands Department, Quebec.
17. Dewar, Miss, London, C. W. *Coleoptera and Lepidoptera.*
18. Edwards, W., Port Stanley, C. W. *Coleoptera and Lepidoptera.*
19. Gibbon, Miss, St. Mary's, C. W. *Lepidoptera.*
20. Girdwood, G. P., Asst. Surgeon, Grenadier Guards, Montreal.
21. Girdwood, Mrs. G. P., Montreal.

22. Grant, Francis, Orillia, C. W. *Coleoptera and Lepidoptera.*
23. Hill, Rev. Geo. S. J., M. A., Markham, County of York, C. W. *Coleoptera and Diptera.*
24. Hincks, Rev. William, F. L. S., Prof. of Nat. Hist. University College, Toronto. *Studies all orders; but does not collect.*
25. Hubbert, James, Knox's College, Toronto, and (during Vacations) Grafton, County of Northumberland, C. W. *Diptera, Neuroptera, and, to some extent, Coleoptera.*
26. Kreighoff, C., Quebec. *Insects of all orders; pays particular attention to Lepidoptera (Heterocera, and Coleoptera.*
27. Lawford, J. M., Toronto. *Lepidoptera and Coleoptera.*
28. Lawrason, W. L., Dundas Street, London, C. W. *Lepidoptera and Coleoptera.*
29. Morris, Beverley R., M.D. Institution for the Deaf and Dumb, and the Blind; 490 Queen street, Toronto. *All orders; but chiefly Coleoptera and Lepidoptera.*
30. Provancher, Rev. L., St. Joachim, Montmorency, C. E. *All orders except Aptera; pays especial attention to Lepidoptera and Coleoptera.*
31. Reed, E. Baynes, London, C. W. *Coleoptera and Lepidoptera.*
32. Reynolds, T., Financial Director, Great Western Railway; Hamilton, C. W. *Lepidoptera.*
33. Rooke, Capt. W. S., Scots Fusilier Guards, Montreal. *Coleoptera and Diurnal Lepidoptera.*
34. Saunders, William, Dundas Street, London, C. W. *All orders; chiefly Coleoptera and Lepidoptera.*
35. Turton, F., Simcoe Street, London, C. W. *All orders; chiefly Coleoptera and Lepidoptera.*
36. Rogers, Robt. V., Jr., St. James' Parsonage, Kingston.

ARTICLE XX.—*On the Chemistry of the Earth.* By T. Sterry Hunt, M. A., F.R.S.; of the Geological Survey of Canada.

Extract of a letter to Elie de Beaumont, published in the Comptes Rendus of the French Academy of Sciences, June 9th. 1862.

On the 28th of October, 1844, a memoir was deposited with the Academy by the illustrious Cordier. Being in a sealed packet, its contents remained unknown until after his death, when at the request of his widow, the seal was broken, and the paper, which bears the date of October 22, 1844, was first made public in the *Comptes Rendus* of the Academy for February 17, 1862. In this remarkable memoir, which has for its title "On the origin of the calcareous rocks which do not belong to the primordial crust," (*De l'origine des roches calcaires, etc.,*) the author gives his views upon the formation of limestone and dolomite. He rejects Von Buch's theory of dolomitization, which still finds some sup-

porters, and which supposes that the magnesia was introduced subsequent to the deposition of the sediments, by a "certain mysterious action of intrusive pyroxenic rocks," which have been ejected in the vicinity of deposits of pure limestone. Mr. Cordier also combats the idea that these last have been formed entirely of the debris of testacea and zoophytes, which according to him, form but a small proportion of limestone formations. Going back still farther, he finds the source alike of the carbonate of lime of these organic remains, and of the great mass of calcareous rocks, in certain chemical reactions. The pure limestones, according to him, pass into magnesian limestones by an admixture of dolomite, and form thus a transition to the pure dolomites, so that we must admit a common origin for all these rocks. The source of the two carbonates which compose them, according to Mr. Cordier, is to be found in the reaction of carbonate of soda upon the chlorids of calcium and magnesium in sea-water; the carbonate of soda being derived from the decomposition of feldspars, from alkaline springs, and from plutonic emanations. This alkaline salt, reacting upon the salts of sea-water, would give rise to chlorid of sodium and carbonate of lime, and under certain conditions, to calcareo-magnesian precipitates. From this reaction must result a secular variation in the composition of the ocean, which corresponds to the progressive changes in the marine fauna of successive geological epochs.

Such is the theory of Mr. Cordier, which is now published, for the first time, in 1862; and which I have thus noticed in order to call the attention of the Academy to my own published papers, in which I have maintained similar views for the last four years. In The American Journal of Science for January, 1858, I endeavored, in admitting the igneous theory of the earth's origin, to obtain some notion of the chemical conditions of the cooling globe, by supposing the matters which now form the earth's crust to be fused together by an intense heat. From this would result an atmosphere holding, in the state of acid gases, all the carbon, the sulphur, and the chlorine, besides the elements of air and water; while the bases, such as the alkalies, lime, magnesia, oxyd of iron and alumina, in combination with silica, would form the solid crust. This would afterwards be attacked by the acids precipitated, with water, under the pressure of a high atmospheric column, and at an elevated temperature; from which would result the separation of a great amount of silica, and the formation of an ocean, whose waters

would contain in the state of chlorids and sulphates, not only alkalies, but also large portions of lime and magnesia. At a later period, the decomposition of exposed portions of the silicated crust under the influence of water and carbonic acid, would give rise, on the one hand to clays, and on the other to carbonate of soda. This latter, reacting upon the calcareous salts of the sea-water, must produce chlorid of sodium and carbonate of lime. We have here a theory of the source of the quartz, the carbonate of lime, and the argillaceous matters of the earth's crust, explaining at the same time the origin of the chlorid of sodium of the sea, and the fixation of the carbonic acid of the atmosphere in the form of carbonate of lime. In this is seen a great and harmonious series of chemical processes, which have operated, and which continue to operate at the surface of the globe. These notions of the chemistry of the earth has been taught in my public lectures for the last four years, and will also be found in a paper read before the Geological Society of London on the 5th of January, 1859, and published in the Quarterly Journal of the same Society for that year, p. 488. In support of these views will be found the results of a series of investigations published in the Reports of the Geological Survey of Canada, and in the American Journal of Science for 1859, upon the reactions of solutions of bicarbonate of soda with sea-water, and upon the conditions required for the precipitation of carbonate of magnesia and the formation of dolomite. We have there also shown the mutual decomposition at ordinary temperatures, of solutions of bicarbonate of lime and sulphate of magnesia, resulting in the formation of gypsum, and of a soluble bicarbonate of magnesia, which becomes the source of dolomite or of sepiolite. A notice of the first part of these researches will be found in the *Comptes Rendus* for May 23, 1859. In the continuation of them, as cited above, it has been shown that the association of magnesian and pure limestones, establishes the fact that these rocks have both been deposited as sediments, and that the hypothesis which explains the origin of dolomites by a subsequent alteration of pure limestones is inadmissible. It was also shown that great portions of limestone, even in fossiliferous formations, have the characters of precipitates resulting from chemical reactions, and have never formed part of organised beings; which last, moreover, owe their carbonate of lime to similar reactions.

My views upon the composition of the primitive ocean were

farther supported by the analyses of numerous saline waters from Lower Silurian limestones. In these waters, the bases of which are almost wholly in the condition of chlorids, about one-half of the chlorine is combined with sodium, and the other half is nearly equally divided between calcium and magnesium.

The Academy will perceive from the short analysis above given, the extent and the importance of my generalizations, with which the ideas of Mr. Cordier are, for the most part, in perfect accordance. It will farther be observed, that the publication of Mr. Leymerie, in which similar views are, to a certain extent, indicated, (see the *Comptes Rendus* of March 10, 1862,) dates only from 1861, while my own papers appeared in 1858 and 1859.

My researches upon the origin of dolomites and limestones fully justify the previsions of Mr. Cordier. He however, in his theory, excepted the limestones of primitive formations, but these are known to modern geologists to be nothing more than metamorphosed sedimentary formations, and consequently offer no exception to the general view. The different sources of carbonate of soda indicated by Mr. Cordier, may moreover be reduced to a single one, inasmuch as both the salts of alkaline springs, and those of what he calls plutonic emanations, are probably derived from the decomposing feldspathic minerals of sedimentary rocks. The argillaceous rocks, deprived of a large proportion of the alkali which they once contained in the form of feldspars, are the equivalents of the limestones which have been formed at the expense of the chlorid of calcium of the primitive ocean.

The waters of certain rivers contain alkaline carbonates, in some cases with notable proportions of silica and potash; an example of this is found in the water of the Ottawa. The presence of silica and potash in river waters appears to be in great part due to the soluble matters derived from the decomposing vegetation of peat bogs, for in the waters of deep-seated springs, both neutral and alkaline, the salts of potash are generally found in very minute quantities. This is not surprising when we consider the great stability of potash-feldspar, and also the power which aluminous soils possess of removing silica and potash from infiltrating waters, and of replacing the latter by soda. Atmospheric waters thus dissolve from sediments only the soda, lime and magnesia which these contain, and, with the intervention of organic matters, oxyd of iron, and sometimes oxyd of manganese. It results from these affinities that the sediments which are most silicious, and conse-

quently most porous, retain at last little more than silica, alumina and potash; while the more or less impalpable and impermeable sediments, which include large proportions of clay and marl, retain their soda, lime, magnesia and oxyd of iron, and yield, when metamorphosed, triclinic feldspars, pyroxene, hornblende, and other minerals of basic rocks. The alteration of the more silicious and thoroughly lixiviated rocks, on the contrary, will yield chiefly orthoclase, mica and quartz. In this way is explained the origin of the two great classes of rocks, the granitic or trachytic, and the pyroxenic types. These two types appear alike among the metamorphic strata, and the intrusive masses, which last we have distinguished by the title of *exotic rocks*, regarding them as displaced metamorphosed sediments, while the metamorphic strata *in situ* are *indigenous rocks.* It follows as a consequence of the principles above defined, that the composition of aluminous sediments must vary in the different geologic epochs. In the Laurentian, which is the oldest known system, rocks, having a base of triclinic feldspars, which contain much soda, abound, while argillaceous rocks, like argillites, are unknown. These however become abundant in more recent formations, where natriferous anorthites, like those of the Laurentian system, are comparatively rare. (See farther Quar. Jour., Geological Society, 1859, p. 488, and Am. Jour. of Science.)

ARTICLE XXI.—*Description of a new Enaliosaurian from the Coal Measures of Nova Scotia. By O. C. Marsh, B. A.*

(*Abridged from Silliman's Journal.*)

The Reptilian remains from the Coal-measures, hitherto described, are few in number, and have nearly all been regarded as Batrachian, or Amphibian. Previous to the year 1844, the existence of even this low form of reptilian life during the Carboniferous period was unsuspected by most geologists, and its first appearance upon the earth confidently referred to the Permian epoch. In that year Herman von Meyer announced the discovery in the Rhenish Bavarian Coal-measures of a reptile allied to the Salamanders, which he described under the name *Apateon pedestris;** and about the same time Dr. King published an account of the footprints of a large Batrachian, which he had

* Leonhard and Bronn, *Neues Jahrbuch für Mineralogie*, etc., 1844, page 336.

observed in the coal strata at Greensburg, Penn.* In 1852 Sir Charles Lyell and Prof. J. W. Dawson obtained in the Coal-measures of Nova Scotia the bones of the *Dendrerpeton Acadianum* (Wyman and Owen), which were the first reptilian osseous remains described from the Carboniferous rocks of America.†

Since these discoveries were made, the Coal-fields of England and Nova Scotia, as well as those of Ohio and Pennsylvania, have afforded additional Batrachian, or Amphibian, bones and foot-prints, so that at the present time the prevalence of this type of reptilian life during the Carboniferous period is generally admitted. The more recent researches of Prof. Dawson in the Coal formation of Nova Scotia have been rewarded by the important discovery of a new genus (*Hylonomus*) of very small reptiles, which, he considers, had affinities to the Lacertians, and possibly belonged to that family, rather than to the Batrachians.‡

The remains which form the subject of the following description are of great interest, since they indicate the existence during the Palæozoic period of a group of highly organized marine reptiles of large size, which have previously been found only in Secondary strata. These remains consist of two vertebræ, or more strictly two centra or bodies of vertebræ. The vertebræ was discovered by the writer in August, 1855, while examining the Coal-measures of Nova Scotia in company with his friend, Mr. William E. Park, of Andover, Mass. Their resemblance in form and appearance to the vertebræ of an *Ichthyosaurus* was so marked, that at the time of the discovery the writer referred them to that genus, and made a careful exploration in the vicinity for further remains, but without success. As soon as an opportunity occurred, the fossils were compared with the vertebræ of *Ichthyosauri* from the Lias, and, although some points of difference were noticed, the Enaliosaurian characters seemed to be equally well marked in each. Wishing to obtain, if possible, some additional remains, the writer for some time deferred publishing a description of the vertebræ; but a careful re-

* Description of fossil footmarks (of *Thenaropus heterodactylum*) found in the Carboniferous series in Westmoreland County, Penn.; by Alfred T. King, M.D., Am. Journal of Science. vol. xlviii, page 343. Also in vol. i, new series, page 268.

† On the remains of a reptile (*Dendrerpeton Acadianum*, Wyman and Owen), and of a land shell discovered in the interior of an erect fossil tree in the Coal-measures of Nova Scotia; by Sir Charles Lyell, F.R.S., &c., and J. W. Dawson, Esq. Quarterly Journal of the Geological Society, London, May, 1853, vol. ix, p. 58.

‡ Proceedings of the Geological Soc. of London, 1859. Also Supplement to Acadian Geology, page 33.

examination of the locality during the past summer afforded nothing of a similar nature, and there seemed to be no reason for longer delay in announcing so important a discovery. The remains were, accordingly, briefly noticed by the writer in the last number of the American Journal of Science; and, as they appeared to be generically distinct from any hitherto described, he then proposed for the species the name *Eosaurus Acadianus*, in allusion to the early appearance on the earth of this higher type of reptilian life.*

The locality which furnished these fossils is at the South Joggins Coal formation, in Nova Scotia, on the southern shore of the Chiegnecto channel, a branch of the Bay of Fundy. The Coal-measures at this place, according to Sir W. E. Logan, have† a vertical thickness of 14,570 feet, or nearly three miles; and contain seventy-six distinct seams of coal, with erect trees and plants at twenty-two different levels. The strata dip to the south at an angle of about 25°; and the destructive tides of the bay are constantly undermining the high cliffs, and exposing for miles along the coast fresh sections, rich in fossil treasures of vegetable and animal life.

The present remains were imbedded in a stratum of argillaceous chocolate-colored shale, which forms part of group XXVI. in the elaborate section of the formation made in 1852 by Sir Charles Lyell and Prof. J. W. Dawson.‡ The position of this group is a little more than 10,000 feet above the lower limits of these Coal-measures, and beneath nearly 5,000 feet of coal strata, containing at least twenty separate veins of coal. It is about 800 feet above the locality which afforded the remains of the *Dendrerpeton* and *Hylonomus*.

This group is sixty-six feet in thickness; and consists of chocolate and gray shales, containing ironstone nodules, and interstratified with bands of gray sandstone, in which may occasionally be observed ripple marks, and carbonized land plants. Erect *Sigillariæ*, often of large size, occur at one level, and erect *Calamite* at another. Prof. Dawson considers these deposits estuary or fluviatile sediments, covering flats, which were at times dry, or near-

* From ἠώς the dawn, and σαῦρος, a lizard. The specific appellation is from Acadia, a former name of Nova Scotia.

† First Report on the Geology of Canada, 1845.

‡ Transactions Geological Society of London, 1853.

ly so, and at others inundated. On one of the rippled sandstones he noticed a series of footprints, which he supposes might have been made by a large *Dendrerpeton.*

Group XXV., immediately beneath the locality of the vertebræ is about twenty feet in thickness; and consists of a series of underclays, or fossil soils, with *Stigmaria*, and small seams of coal, in which may be seen *Sigillariæ* and *Lepidodendra.* Two feet below group XXVI. there is a stratum of bituminous limestone, which contains the scales of ganoid fishes (*Palæoniscus*), coprolites, bivalve shells of the genus *Naiadites* and *Spirorbis carbonarius* attached to plants and trunks of *Sigillariæ.*

The vertebræ, as already stated, are two in number: and when discovered were attached to each other. Their uniformity in size and appearance, as well as their collocation when found, would indicate that they belonged to the same animal, and were contiguous in the vertebral column. They are remarkably well preserved; and this results from their complete ossification in their natural state, as well as from the peculiar matrix which has since contained them, and furnished the material for their mineralization. The posterior vertebra, in fact, with the exception of a small fracture, seems to be nearly as perfect as in its original condition; and from it the description and measurements which follow are mainly taken.

A close examination of the fossils shows, that subsequent to the death of the animal, and before being imbeded in the shale, they were subjected to considerable violence. One of them has been pushed aside from its original position about one-third of its diameter, and also turned on its axis about 90°, so as to leave its superior surface in apposition with the lateral surface of its fellow. Through the center of the anterior vertebra an irregular cavity has been made, and a wide fissure separates a segment from the rest of the centrum. The edges of each of the fossils are somewhat abraded, apparently from having been rolled about by water: this, however, could not have been long continued; as the delicate reticulate texture of the non-articular surfaces, being protected by their slight concavity, is perfectly preserved These injuries were evidently received before the entombment of the vertebræ; and, as no similar remains could be found in the vicinity when these were discovered, it is quite probable that the same force, which caused the injuries, also widely separated the different parts of the skeleton.

The general form of the vertebræ is cylindrical, but their sides, are somewhat compressed obliquely, which gives to the contour of the center a sub-hexagonal appearance. They are much flattened in the direction of the antero-posterior diameter, which has to the transverse diameter about the proportion of 1 to 3. Both the articular terminal facets are deeply and equally concave; but from the center to the margin, the surfaces are convex, and this convexity is greatest near the center. The cavities for the reception of the intervertebral matter begin immediately from the margin; and are considerably deeper than in the corresponding arts of the *Ichthyosaurus*, indicating a greater degree of flexibility in the spinal column. The margins of the vertebræ are somewhat raised, as if they had yielded to a forcible compression applied longtiudinally and hence the lateral surfaces of the centers are concave in an antero-posterior direction. This concavity is greater in the upper half of the vertebra, and was undoubtedly more marked originally than at present, since the appearance of the margins indicates considerable abrasion. The non-articular surfaces of the centra are smooth and regular; and the external fibres of the osseous tissue are singularly reticulated.

The neurapophyses are not anchylosed to the centrum, as in the mammalia, nor connected to it by sutures, as in the crocodiles; but their union with the vertebra is indicated by two pits, which served for their articulating surfaces. These depressions are situated on the superior surfaces of the centrum, intermediate between the anterior and posterior margins of the extremities. They are circular in form, and sink directly into the body of the vertebra; instead of being elongated longitudinally, and raised on ridges, as in the *Ichthyosauri*. The pits are about a line in depth, and in the more perfect of the fossils are not in their original position; as a fracture in the upper part of the centrum has pushed them obliquely apart, so that a line passing through their centers would form an angle of about 30° with the transverse diameter of the vertebra. The depressions occupy about one-third of the distance between the margins of the articular extremities, indicating that the base of the neural arch was of less antero-posterior extent than the centrum. The floor of the spinal canal is narrow, being but five lines in breadth; and its surface in the posterior vertebra is broken by the fracture previously mentioned, which passes lengthwise through its center. No neurapophyses were found with these fossils, but the nature of the superior arch

is indicated by the articular surfaces which served for its attachment. Without doubt its ossification was complete, since the neurapophyses are never inferior in this respect to the body of the vertebra. It is also probable that in the present case these parts were anchylosed to each other and to their spine, as in the neural arch of the *Ichthyosaurus.*

A rudimentary transverse process, or exogenous tubercle, is sent off from each lateral surface of the centrum, at points equidistant from the extremities of the vertical diameter. Their position is near the margin of the anterior articular surface, and the edges of these parapophyses make the transverse diameter of this extremity somewhat greater than that of the corresponding facet. At the surface of the vertebra, each of these tubercles is about six lines in diameter, but they rapidly diminish in size as they extend outward, and at a distance of one and a half lines from the centrum terminate in obtuse points. They present no indications of articular surfaces; but externally appear to be composed of radiating fibres of osseous tissue, and without doubt served for the attachment of muscles. These elevations resemble in form and position the rudimentary transverse processes on the caudal vertebræ of the *Ichthyosaurus tenuirostris*, and this similarity affords some ground for referring these fossils to the same part of the vertebral column. That their true position is in the anterior or central caudal region, is further indicated by the absence from the centrum of true costal surfaces, or articular depressions for the attachment of ribs, which we should expect to find present in the cervical or dorsal part of the spinal column; and also by the absence of a lateral compression of the centers, which, in the *Ichthyosauri*, marks the posterior caudal vertebræ. Both of the fossils are somewhat injured on their inferior surfaces, and hence it is impossible to ascertain from the specimens themselves whether hæmapophyses originally existed.

A microscopic examination of the osseous structure of these vertebræ of the *Eosaurus* exhibits well-marked reptilian characters. The Haversian canals are few in number, but large in size, as is usual in this class. The lacunæ, although somewhat irregular in shape, are much elongated, and show very little resemblance to the quadrate or stellate form of the bone cells in fishes. They are frequently arranged concentrically around the Haversian canals, and their walls are almost invariably well defined. The canaliculi, as in the *Ichthyosaurus* and *Plesiosaurus*, are not numerous, but appear to be finer than those in most saurians. They

do not taper off and ramify, as in the bones of fishes, nor anastomose with the corresponding tubes from the neighboring cells, although in one of the longitudinal sections there are a few indications of such a connection. Some of the other sections examined show a larger number of canaliculi ; but generally there are only a few of these tubes attached to each lacuna, and in some cases they appear to be entirely wanting. As the canaliculi vary much in number in different saurians, and also with the age of the animal, their paucity in this case is not remarkable. It is possible, however, that the method employed in preparing the sections was not well adapted to rendering these minute tubes visible. In a part of the transverse section a structure is seen, which is quite different from the surrounding osseous substance. This may be due to the presence of a small cavity in the bone before the introduction of the mineral matter, or to an imperfect ossification at that point: more probably the latter, as these vertebræ, like those of the *Plesiosaurus*, show in their interior structure a degree of ossification somewhat inferior to that at the articular terminal surfaces.

It will readily be seen from the previous description, that a very close resemblance exists between these vertebræ and those of the *Ichthyosaurus*. This is especially noticeable in their flattened and sub-hexagonal form, in their deep and regular terminal concavities, and in the separate state of the neural arch. The differences which exist, however, although of much less importance, must not be disregarded. The most marked of these have already been alluded to; and may be seen in the absence from the sides of the centrum of costal articular surfaces, in the deeper concavities at the vertebral extremities, and in the form and dimensions of the superior arch. The first of these differences would alone be deemed sufficient, by the highest authority, to establish a distinction between these remains and the vertebræ of the *Ichthyosaurus;* for in that genus, according to the statement of Prof. Owen, which is peculiarly applicable to the present case,—"The lower tubercle for the attachment of the rib never wholly quits the centrum: any detached vertebral centrum therefore that might be discovered, which had no lateral tubercle or articular surface for a rib, might be safely pronounced, whatever the form of its anterior and posterior articular surfaces, not to have belonged to a true *Ichthyosaurus*, provided it was not compressed laterally, as in the small terminal ribless caudal vertebræ which supported the caudal

fin in the *Ichthyosaurus*."* The absence of any lateral compression in the present remains, together with their size and proportions, prove conclusively that they cannot be brought under the exception which Prof. Owen makes of the terminal caudal vertebræ of the *Ichthyosaurus;* and hence the application of his rule would separate them from that genus.

The points of similarity, then, between these vertebræ of the *Eosaurus*, and those of the *Ichthyosaurus*, which they most resemble, clearly indicate that they belong to the same natural group of marine reptiles, and to the same order; while the differences which exist between them seem to be sufficiently numerous and important to authorize the conclusion that they are generically distinct; as might naturally be expected from the vast periods of time that separated their existence.

Since the genera of Enaliosaurians from the secondary formations, although contemporaneous, differed so widely in form and structure, analogy would lead us to infer that a Palæozoic representative of the family would present still more marked peculiarities in these respects. It is, therefore, particularly interesting to find indications of so strong a resemblance between this primitive saurian and the more recent *Ichthyosaurus*. These fossils, however, present some features of a lower and more ichthyic type of structure than that genus possessed, and it is not unlikely that other parts of the skeleton would show a wider divergence.

These vertebræ of the *Eosaurus*, although the only remains of the genus at present known, are so characteristic and well preserved that they afford considerable evidence in regard to the structure and habits of the animal to which they belonged. They indicate that this reptile, like the later Enaliosaurians, was of great size,* air-breathing, cold-blooded, and carnivorous; that it was aquatic, and probably marine, inhabiting the sea or estuaries; or possibly, as might be inferred from the place of its entombment, the mouths of rivers flowing into the sea.† The

* Report on British Fossil Reptiles, Part I, page 102.

* If we suppose the number of vertebræ and the relative length of the head of this saurian to have been the same as the *Ichthyosaurus*, its entire length must have been between twelve and fifteen feet, which is at least three times the extent of any reptile hitherto found in Palæozoic strata.

† Although the strata which contained the vertebræ are probably fluviatile or estuary deposits, this would not preclude the possibility of their containing marine remains; as the waters from which they were precipitated were undoubtedly so connected with the sea that an occasional transfer of the inhabitants from one to the other might readily be made. Analogous cases are not uncommon at the present time.

flattened form of the vertebræ; the great depth of their terminal concavities; the separate condition of the neural arch; and its short longitudinal extent at the base,—all are consistent with the conclusion that the *Eosaurus* was capable of rapid progress through the water in pursuit of its prey, which was probably fishes; and since it had then, according to our present knowledge, no superior in point of size, it must have reigned supreme in the waters of the Carboniferous era.

As the vertebræ which have been described in this paper were discovered in 1855, they are, consequently, so far as the writer is aware, the first osseous remains of a true air-breathing Saurian from the Coal formation; and the only *Enaliosaurian* remains yet obtained from below the Upper Triassic. Occurring as they they do in Palæozoic strata, they add another to the arguments that have been brought against the so-called "Development Theory;" and they show with how great caution we should receive the assertions, so frequently and confidently made on negative evidence alone, of the exact date of the creation or destruction of any form of animal or vegetable life. They prove, moreover, that during the deposition of the Coal-measures the atmosphere was sufficiently free from the destructive gases, which, many suppose were contained in it, to permit the existence of a high type of air-breathing reptiles. This period was, in fact, the foreshadowing of an age, then far in the future, when reptilian life should hold undisputed sway upon the earth, until in turn supplanted by a higher and a nobler form of existence.

REVIEWS AND NOTICES OF BOOKS.

Fourth Report of the Geology of Kentucky, by Owen and others.

Report of the Geological Survey of Wisconsin, by Hall and Whitney.

Report on the Colorado River of the West, by Ives, Newberry, and others.

Report of the Geological Survey of Maine, by Hitchcock.

It is not a little creditable to the people of the United States, that while engaged in the costly and bloody strife for their national existence, they do not wholly intermit their public exertions on behalf of natural science. Each of the above mentioned works

is a bulky volume, and some of them are expensively printed and illustrated, while all are replete with interesting and important scientific facts.

The Kentucky report possesses a melancholy interest in containing the obituary of the head of the survey, Dr. Owen, who closed his useful course in November 1860. It contains an immense amount of valuable local geology by Owen, Lesley and Lyon, and a great number of analyses of ores and soils by Dr. Peter, chemist to the survey. One of its principal features, at least to geologists at a distance, is the palæontological report by Lesquereux, in which he enters into an elaborate investigation of the flora of the several coal seams, with the view of ascertaining their peculiarities, and of obtaining evidence for the determination of the different seams from their fossil plants. We doubt if this last end can be attained to the extent that Mr. Lesquereux anticipates, since our experience has so far led to the belief, that in the middle coal measures the flora is very uniform, and varies rather in consequence of local differences of soil and moisture than from any general cause. The differences, however, in the upper and lower members of this great series are in some respects quite marked; and such investigations as those of Mr. Lesquereux are most praiseworthy and valuable.

The Wisconsin report is occupied in great part with a detailed account of the remarkable deposits of lead, in the form of galena, occurring in the older silurian limestones of Wisconsin and other regions in the West. Prof. Hall contributes the introductory chapter on general geology, and a palæontological report, accompanied with a systematic list, which is in many respects one of the most useful forms in which to present such information. In this list appears the unfortunate little *Lingula*, whose appearance in the report of 1861 has excited some controversy in this Journal. It is proper to state with respect to this, that Prof. Hall explains the misapprehension, as he regards it, in respect to the date of his notice of this species, by the delay which has occurred in the publication of operations stated to have been made long previously. It is one of the misfortunes of the rapid progress of palæontology that it should occasion such interference of workers in this field, and raise suspicions very unpleasant to all parties.

The Colorado report includes the results of the exploration of the largest stream but one flowing from the United States terri-

tory into the Pacific. The physical features of the region are remarkable, presenting a series of deep ravines or "canons" in which the Colorado and its tributaries flow at depths amounting in some cases to two or three thousand feet below the level of the neighbouring table-lands. The scenery presented in these deep cuts is of the most magnificent description, apalling the visitor with its gloomy grandeur. In the lofty precipices the whole palæozoic series of rocks may be seen in regular and undisturbed succession, and resting on older metamorphic rocks; while in the higher table-lands cretaceous and triassic rocks appear, the whole apparently constituting a continuous undisturbed series. Dr. Newberry, the geolcgist of the expedition, has well availed himself of these magnificent exposures. He attributes the present irregular features of the country entirely to aqueous erosion, and this by running water. It is indeed the long prevalence of river action in an undisturbed country that can alone produce such effects.

The survey of Maine, at the opposite extremity of the Union, from the Colorado river, was commenced last year by Mr. Hitchcock, and his report shows a most praiseworthy diligence, and an excellent combination of effort with others working in neighbouring fields, along with great capacity for such work. The observations made and fossils collected enable us for the first time to form just ideas of the parallelism of large portions of the rocks of Maine with those of New York, Canada and Nova Scotia. The lower silurian rocks are represented by clay slates, holding a few fossils regarded as primordial in their type. Other deposits occurring in several places are regarded as upper silurian, and correspond very nearly with the "Arisiag series" of Nova Scotia. There are extensive deposits of Devonian rocks, in one member of which, exposed at Perry, we have three remarkable plant-beds, some of the fossils of which have been noticed in this journal. The drift deposits have also been carefully sketched, and with the aid of Mr. Fowler of Portland, a list of these fossils has been prepared, and comparisons instituted between them and those of the similar deposits in Canada, with which they correspond very closely in their arrangement and fauna. The indications are those of a marine fauna similar to those of the present coast, but with a prevalence of more northern forms indicating a somewhat colder climate. J. W. D.

Descriptive Catologue of the Economic Minerals of Canada and of its Crystalline Rocks, by Sir W. E. Logan and T. Sterry Hunt.

This catalogue, prepared for the Great Exhibition in London, is an instance of that thoroughness which characterises everything attempted by Sir W. E. Logan. It is in truth a descriptive list of everything known to be of economic value in Canadian mineralogy; and must be of immense service to the industrial interests of the province; more especially when practical men in England can compare its clear and accurate statement of facts with actual specimens of the products themselves, as exhibited in London. Mr. Hunt adds a similarly descriptive catalogue of rocks; which with the specimens exhibited, will present to European geologists a better exposition of the lithology of Canada than, in so far as we are aware, any other region on this side of the Atlantic can boast, and one quite equal, to say the least, to anything of the kind afforded by European rock collections.

We copy, as specimens, the notices of a few of the more important of the newer mining localities and their products.

"Ramsay Mines, Ramsay, lot 3, range 6...*Foley & Co., Montreal.*"

"A vein cutting nearly horizontal beds of grey, geodiferous, brown-weathering dolomite. The vein is composed of calcspar, and has a breadth varying from two and a half to five feet, in which the galena is disseminated in a width of from eight to twenty-four inches. In some portions the vein is almost dead ground, while in others, judging by the eye, it would yield nearly two tons of eighty per cent. per fathom. The bearing of the lode is about N.W., and its underlie to the north-eastward, about a foot in a fathom. A trial shaft has been sunk on the lode to the depth of thirty-seven feet, and the working of seventy-five fathoms of ground, in 1858, yielded twenty-six tons of ore of eighty per cent. A smelting furnace was erected to reduce the ore, and a ten horse-power engine used to give blast to the furnace and dry the shaft, but a considerable spring of water having been struck, it became necessary to erect a more powerful engine, and one of fifty horse-power has just been completed. The dolomite is underlaid conformably by sandstone, which crops out about a mile from the mine, and is unconformably supported by crystalline limestone and gneiss of Laurentian age. About 105 fathoms south-eastward from the main shaft, a counter-lode joins the main one, at an angle of about 20°; its course being nearly N.N.E. and S.S.W. At the junction of the two lodes a shaft has been sunk in sand-

stone, to a depth of 21 feet, and in the excavation of the pit, in which the united lodes have a breadth of ten feet, there have been obtained about seven tons of ore of twenty per cent.—*Calciferous formation, Lower Silurian.*"

" Lansdowne, lot 3, range 8................ *Geological Survey.*"

" Ore from a vein cutting crystalline limestone, and running N. 60° W. The vein has a thickness of from six to twelve inches, and is composed of calcspar, in which the galena is disseminated in lumps, which, in a trial shaft of about fifty feet, sunk in 1854, on the land of Mr. Buel, were sufficient to pay the expenses. The largest of these lumps may have been five or six inches in width. A counter-lode diverges from the main one near the shaft, and in this neighbourhood, there occur four additional lead-bearing veins, running parallel with the main one, all contained in a breadth of about 1000 feet. They run obliquely across the lots, and thus intersect the lands of several proprietors. On lot four of the same range, Messrs. Foley and Co., of Montreal, have sunk a small shaft on one of the lodes.—*Laurentian.*"

" Bedford, lot 19, range 7................. *Geological Survey.*"

" Ore from one of five nearly parallel lodes cutting crystalline limestone, in a breadth of about a quarter of a mile, on the property of Mr. Weston Hunt, of Quebec. The gangue of the lode is a mixture of heavy spar and calcspar. About a mile to the eastward of these, are other nearly parallel lodes, also cutting crystalline limestone, on land belonging to the same proprietor. Shallow trial shafts were many years ago sunk on some of these, but what quantity of lead-ore was obtained in them is not known. On lot 13, range 5, of Bedford, Messrs. Foley & Co., of Montreal, have sunk a trial shaft to a depth of fourteen feet, on a lead-bearing lode of six inches, of which the gangue is heavy spar. It cuts crystalline limestone, and reaches gneiss, and in both rocks shows good bunches of ore. This lode is about three miles south-west from those first mentioned, and runs parallel with them.—*Laurentian.*"

" N.B.—The distance between the Lansdowne and Bedford lodes is about twenty-five miles; they bear for one another, and it appears not at all improbable that the veins in the two localities may be identical, or belong to one group. If a line from the Bedford to the Lansdowne lodes were continued twenty-five miles farther, it would cross the St. Lawrence, and strike Rossie in St. Lawrence County, New York, where a well known group

of veins of lead ore intersects Laurentian gneiss. Though just now abandoned, some of these are supposed to be still unexhausted, and two of them are known, at one period, to have yielded a great quantity of ore; one of them as much as $142 worth to a fathom. The Ramsay lode belongs to a series of veins which run parallel with those of Bedford, at a distance of about forty miles to the north-eastward, and although the two groups cut different rocks, both are probably of one age, which would not be older than that of the *Calciferous formation* of the *Lower Silurian* series."

"Bruce Mines, Lake Huron,...........*Montreal Mining Co.*"

"At the Bruce mines, a group of lodes traverses the location in a north-westward direction, intersecting a thick mass of interstratified greenstone trap. The strata here present an anticlinal form, the lodes running along the crown of it. All of the lodes contain more or less copper ore, which is disseminated in a gangue of quartz. The main lode, which is worked with another of about the same thickness, is, on an average, from two to four feet wide. In a careful examination made in 1848, about 3000 square fathoms of these lodes were computed to contain about 6½ per cent. of copper. The quantity of ore obtained from the mine, from its opening in 1847, was 472 tons of seventeen per cent The deepest working is fifty fathoms from the surface. The number of men employed is thirty-four. Smelting furnaces, on the reverberatory principle, were erected at the mine in 1853; the fuel used in these was bituminous coal imported from Cleaveland; but after a trial of three years, the Company themselves ceased smelting, and subsequently leased their smelting works to Mr. H. R. Fletcher. At present, the ores are in part sent to the Baltimore market, and in part to the United Kingdom.—*Huronian.*"

"Wellington Mine, Lake Huron,..... *West Canada Mining Co.*"

"The lodes of the Wellington Mines are probably a north-westward continuation of those of the Bruce Mine. They are of the same general character, some of them occasionally reaching a thickness of ten feet. They occur on the ground of the Montreal Mining Company, from whom they are leased by the West Canada Mining Company at a royalty, and continue in the adjoining lot called the Huron Copper Bay location, where they are worked by the same Company. The quantity of ore obtained by this Company, from the Wellington mine, since 1857, is a little over 6000 tons of twenty per cent. In 1861, the quantity was 1175 tons of

nineteen per cent., and from the Huron Copper Bay mine, probably about 1300 tons; making the total quantity obtained by the two mining companies in that year about 3000 tons. The deepest working on the West Canada Company's ground is about twenty fathoms. The number of men employed on the Wellington and Copper Bay mines is supposed to be about 260. All of the ore raised by this Company is sent to the United Kingdom.—*Huronian.*"

" Acton Mine, Acton, lot 32, range 3,

W. H. A. Davies and C. Dunkin, Montreal."

"The ore of the Acton mine occurs in masses subordinate to the stratification, at the summit of a band of greyish white and reddish grey compact sub-crystalline dolomite, from 200 to 300 feet thick, belonging to the base of the Quebec group. The dolomite is divided into two massive beds; it is associated with a good deal of chert, and encloses mammillated fibrous concretionary forms, resembling those of travertine. At the summit, the dolomite often terminates in a breccia or conglomerate, with angular and rounded masses of limestone, intermingled with ragged, irregular masses of chert. In many places the dolomite is marked by the occurrence of the yellow, variegated and vitreous sulphurets of copper, which are in patches, running with the stratification. In the neighbourhood of these, many veins, and strings and veins of quartz interset the rock, in various directions, and hold portions of the sulphurets of copper. The copper ores which often contain native silver, appear to be more abundant in the upper part of the rock. At Acton the conglomerate is separated from the main body of the dolomite by between eighty and ninety feet of dark grey or black slates, intermixed with diorite; in these the conglomerate lies in large isolated masses, running parallel with the summit of the main body of the dolomite. On the opening of the mine, the sulphurets, where most abundant, appeared partially to surround them; in some parts constituting the paste of the conglomerate. As the work proceeded, many slips and dislocations, of no great magnitude, where found to cut the strata. Some of them appear to run with the strike, and others in two parallel series, oblique to one another. These disturb the regular continuity of the copper-bearing bed, producing apparent undulations in the dip, and causing the diorite and the limestone to protrude into the copper ore, or unexpectedly to interrupt one another. The ores were found to be concentrated in three large masses,

occurring in a length of about 120 fathoms. Proceeding south-westwardly, the space occupied by the most northern mass, from a breadth of a few inches, gradually widened out to about ten fathoms, in a length of about forty fathoms; beyond which it appeared to be thrown about fourteen fathoms, obliquely to the westward. The general bearing of the succeeding two masses was still to the south-west. They were about fifteen fathoms apart, and the larger or more southward one swelled to a breadth of more than fifteen fathoms. The depth to which the ground has been worked on the general slope of the bed, is about ten fathoms. The cupriferous rock at this depth has a breadth of about twelve feet in a shaft on the northern mass, and shows rich ore in the floor and the parts adjacent; but with the exception of what is called Pike's pit, in the most southern part, the floors of the other masses do not at present exhibit that same abundance of ore which characterized the upper part. The working of the mine however up to the present time, has been confined to the extraction of the rich ore which was in sight. Little or nothing has been done for discovery, and it cannot be said how near to the present floor of the mine, may be found other masses, similar to those that have been excavated. Beyond these masses in opposite directions on the surface, the ore becomes more scattered in the strata; but there is evidence of its continuance for several hundred feet, in spots and patches occasionally aggregated into masses of much less importance than the three principal ones. In the first few weeks' work in 1859, about 300 tons of ore, containing nearly thirty per cent. of copper, were quarried, in open cuttings, from two of the masses, without making much apparent impression on the quantity in sight. The total quantity sent from the mine up to the end of 1861, is said to be nearly 6000 tons; holding on the average about seventeen per cent., of copper.—*Quebec group, Lower Silurian.*"

The catalogue gives similar details respecting our deposits of iron, nickel, silver, gold, chromic iron, petroleum, plumbago, building stones, marbles, slates, clays, &c., and should be in the hands of every one interested in the economic geology of the country. It is, we believe, on sale at the bookstores. J. W. D.

MISCELLANEOUS.

NOTICE OF THE NATURAL HISTORY COLLECTIONS OF THE MCGILL UNIVERSITY.

The collections of the University in Natural History, which have been accumulating under the care of Dr. Dawson, are now placed in the new rooms provided by the liberality of Mr. Molson, though the naming of the specimens has not been quite completed, and will still require much time.

The principle of arrangement adopted has been that of disposing in flat and wall glass cases, suites of specimens illustrative of the subjects of the lectures in Natural History, in the order in which they are taken up in the lecture room. Geographical collections, and duplicate and extra specimens are placed in drawers under the cases in which objects of similar character are arranged. The greatest possible facilities will thus be afforded to the elementary student, while there will also be opportunity for farther and more detailed study.

The whole collection numbers about 10,000 specimens, of which about 2000 have been collected by Principal Dawson, or contributed from his private collection. The remainder have been procured by purchase or exchange, or by donations from friends of the University. The specimens may be grouped under the following heads:

1. *Mineralogy.*—The basis of this department is the collection of about 2000 Canadian and foreign minerals acquired from the late Dr. Holmes. To this have been added several species and varieties by donation and purchase.

2. *Geology and Palæontology.*—In this department are the fossils of the Holmes collection; the collections of rocks and fossils presented by Sir W. E. Logan, and numbering 475 specimens; collections of British fossils presented by H. Chapman, Esq., G. Evans, Esq., and others; collections of tertiary and carboniferous fossils, and local collections from the Azores, Murray Bay, Lake Superior, Lake Huron, &c., contributed by the Principal; with a great number of miscellaneous specimens, donations from friends and students. This collection is still very incomplete in Permian, Triassic, and Tertiary rocks and fossils.

3. *Zoology.*—In this department there are about 300 specimens of Vertebrate animals, selected as far as possible with a view

to illustrate orders and families. Many of these specimens have been acquired by purchase, a few have been collected for the College, and there are valuable donations from J. Barnston, Esq., and others. In Articulates we have the Couper collection of 2400 specimens of Canadian insects, the Coleoptera of which, numbering nearly 700 species, have been catalogued by Le Conte; a miscellaneous collection of insects arranged by Mr. D'Urban to illustrate the orders and families; and a collection of British Hymenoptera presented by the same gentleman. In Arachnida, Crustacea, and Annelida, the collection is still incomplete, though there are a number of valuable specimens, collected by the Principal, or contributed by Mr. R. J. Fowler and other friends. In Mollusks the basis of the collection consists of specimens presented by H. Chapman, Esq.; the valuable collection of South Sea shells presented by Sir Wm. Dennison; 100 species of fresh-water shells acquired from Mr. Anthony, and duplicates from the Principal's collection. There are also a valuable collection of Norway shells presented by R. McAndrew, Esq., the commencement of a local Canadian collection, some rare and specially interesting species obtained by purchase, and donations from several friends. The collection of Radiates consists of specimens procured by the Principal, with donations from the Smithsonian Institute, Mrs. J. Redpath, Miss Carey, Rev. C. C. Carpenter, Mr. Fowler, Mr. Packard, and other friends. It is more full in Echinoderms than in any other class, and is still very incomplete in corals and their allies.

4. *Botany.*—The principal part of this collection is the Holmes Herbarium of 500 Canadian plants, exclusive of the grasses and carices, which though named and revised by Col. Munro, have not yet been catalogued. There is also a collection of sixty specimens of Canadian woods collected by the late Dr. Barnston; a collection of Canadian woods presented by D. Davidson, Esq.; a collection of Australian woods presented by Sir Wm. Dennison, and collections of mosses, lichens, fungi and algæ. The whole of these are now very conveniently arranged in a separate room. Only the commencement of a collection of exotic plants has as yet been made.

5. *Ethnology, &c.*—In this department there are a number of Indian relics from Montreal, presented by the Principal, several valuable casts of antiques presented by Mr. Blackwell, and a number of miscellaneous objects. It is not intended however to de-

velop the collection much in this direction, as the available space is not more than sufficient for the specimens required in Natural History proper.

Measures are now in progress which it is hoped will tend to supply some of the principal deficiencies, and add useful geographical collections, so as to make the Museum all that it is intended to be, a small but thoroughly serviceable collection for the purpose of instructing students, and facilitating the research of local naturalists, for which purposes it will be in constant use. No attempt will be made to amass a large general collection like that of the Natural History Society, or to rival either that institution or the Geological Survey in the departments in which they are eminent. After securing a sufficient general collection of types for educational purposes, any farther additions will be made as far as possible in objects not adequately represented in the other collections in the city. Its arrangement in the new building will much facilitate the labours of the professors of Natural History and Mineralogy, and it is hoped, add new interest to the subject in the minds of students.

It is intended that every specimen shall be labelled with its name, locality, and donor, and this work has been already in great part accomplished, so that it is hoped that the Museum may be opened to students at the commencement of next session on the 6th September.

"*On the Land Flora of the Devonian Period in North-Eastern America.*" By J. W. Dawson, LL.D., F.R.S.

(*From Abstracts of the Proceedings of the Geological Society of London.*)

First noticing what was formerly known of the Devonian Plant-remains in these states of New York and Pennsylvania (Hall, Vanuxem, and Rogers), in Gaspé (Logan), in New Brunswick and Main (Gesner, Robb, Bennet, Hartt, Matthew, and Hitchcock), the author stated that with Messrs. Hartt, Matthew, and others at St. John's, he had lately examined the productive localities near that city, and is now enabled to add largely to the account of the Devonian plants he had already published in the 'Canadian Naturalist,' vol. vi. 1861. He now enumerates about 70 species (32 genera) of plants as occurring in Upper Devonian of Pennsylvania, New Brunswick, Maine, New York, and Gaspé, in the Middle Devonian of New York and Gaspé, and in the Lower Devonian of Gaspé. Of these 70 species, two (*Psilophyton princeps* and *Cordaites angustifolia*) are referred also to the Upper Silurian

of Gaspé; and 10 (not including these two) reappear in the Carboniferous strata. The Devonian Flora is less perfectly preserved than that of the Coal-measures, and is probably yet very imperfectly known. It presents more resemblance to the floras of the Mesozoic period and of modern tropical and austral islands than the coal-plants. The facies of the Devonian Flora in North America is very similar to that of the same period in Europe.

NATURAL HISTORY SOCIETY OF MONTREAL.

The Annual Meeting of this Society was held in their rooms yesterday evening, the President, the Most Reverend the Lord Bishop of Montreal and Metropolitan in the chair. A large attendance of the members was present. The Recording Secretary, Mr. John Leeming, read the minutes of the last meeting; after which his Lordship the President said:

Gentlemen,—It becomes my duty once more, on this occasion of the Annual Meeting of our Society to give some account of our proceedings during the past year. I confess that it is with no small consciousness of my own unworthiness for the post I occupy, that I now again address you as your President; because I cannot but feel that I have myself been able to do so very little for the advancement of those objects, which it is the business of such a Society to investigate and illustrate. I can however, most truly lay claim to a warm interest in its success, to an anxious desire to encourage in every way I can, the learned and useful labours of others; and I do most sincerely rejoice in being able to congratulate you on the success of those labours, and the steady advance which the Society is making in general usefulness, and in the estimation of the public. The more direct and systematic work of the Society is that which is done at the regular monthly meetings of the members; where papers are presented and read upon any of those subjects which come at all within the purvieu of this Institution; and discussions and conversations take place respecting them. As will necessarily be the case, where science of any kind is the subject matter, these may not always be equally interesting to the million, but are sometimes, as Hamlet says, "caviare to the general;" yet they have been valuable, as contributions to the cause of Natural Science, in almost every department, and have been afterwards preserved and widely disseminated in the bi-monthly numbers of the *Canadian Naturalist.*

edited in this city by some of our members. These may be classed under seven different heads, numbering altogether about 35 original papers, exclusive of Dr. Smallwood's valuable meteorological tables; viz:—Geology, 13; Zoology, 12; Botany, 5; Ethnology, 1; Meteorology, 1; Philology, 1; Chemistry, 2.

List of original papers read before and presented to the Natural History Society of Montreal, from May, 1861, to May, 1862:—

On the Pre-carboniferous Flora of New Brunswick, Maine, and Eastern Canada. By J. W. Dawson, LL.D., F.G.S.

On the origin of some Magnesian and Aluminous Rocks. By T. Sterry Hunt, M.A., F.R.S.

Considerations relating to the Quebec Group, and the Upper Copper-bearing rocks of Lake Superior. By Sir W. E. Logan, F.R.S.

Notes on the History of Petroleum or Rock Oil. By T. Sterry Hunt, M.A., F.R.S.

List of recent Land and Fresh-water Shells collected around Lakes Superior and Huron in 1859-60. By Mr. Robt. Bell.

Catalogue of Birds collected and observed around Lakes Superior and Huron in 1860. By Mr. Robert Bell.

On the Mammals and Birds of the District of Montreal. By Archibald Hall, M.D., L.R.C.S.E. (A paper for which a silver medal was awarded by the Society to its author in 1839, but never before printed; it is now in course of publication).

On some of the Rocks and Fossils occurring near Phillipsburgh, Canada East. By E. Billings, F.G.S.

Recollections of the Swans and Geese of Hudson's Bay. By Geo. Barnston, Esq.

On the occurrence of Graptolites in the base of the Lower Silurian. By E. Billings, F.G.S.

A short review of the Sylviadæ or Wood-warblers found in the vicinity of Montreal. By H. G. Vennor.

Additional Notes on Aboriginal Antiquities found at Montreal. J. W. Dawson, LL.D., F.G.S.

Mr. Barrande on the Primordial Zone in North America, and on the Taconic System of Emmons. By T. Sterry Hunt, M.A., F.R.S.

List of Coleopterous Insects collected in the County of Lincoln, C. W. By D. W. Beadle.

On the recent discoveries of Gold in Nova Scotia. By J. W. Dawson, LL.D., F.G.S.

On the origin of the name "Canada." By Rev. B. Davies, LL.D., Member of the Council of the Philological Society of London.

An account of the Animals useful in an economic point of view to the various Chippewyan Tribes. By B. R. Ross, H.B.C.S.

On the Land and Fresh-water Mollusca of Lower Canada, with thoughts on the general geographical distribution of Animals and Plants throughout Canada. By J. F. Whiteaves, F.G.S., Honorary member of the Ashmolean Society of Oxford, &c., &c.

On the Primitive Formations in Norway and in Canada, and their Mineral Wealth. By Thomas Macfarlane.

On the Shore Zones and Limits of Marine Plants on the North-Eastern Coast of the United States. By the Rev. Alex. F. Kemp.

Contributions to Meteorology for the year 1861 from observations taken at Isle-Jesus, Canada East. By Charles Smallwood, M.D., LL.D., Professor of Meteorology in the University of McGill College, Montreal.

Note on the Taconic System of Emmons. By T. Sterry Hunt, M.A., F.R.S.

Notes on the Flora of the White Mountains, in its Geographical and Geological relations. By J. W. Dawson, LL.D., F.G.S.

On the failure of the Apple Trees in the neighbourhood of Montreal.—A communication to the Committee of the Natural History Society of Montreal. By John Archbold.

On an Erect Sigillaria and a Carpolite from the Joggins, Nova Scotia. By J. W. Dawson, LL.D., F.G.S.

The New Spectrum discoveries. By Professor Robbins.

List of Diurnal Lepidoptera collected (unless otherwise specified) in the immediate vicinity of London, Canada West. By W. Saunders.

An account of the Botanical and Mineral products, useful to the Chippewyan Tribes of Indians, inhabiting the McKenzie River District. By Bernard R. Ross, H.B.C.S.

List of Mammals, Birds, and Eggs, observed in the McKenzie River District, with Notices. By Bernard R. Ross, Corresponding Member, Nat. Hist. Soc., Montreal.

Notes on Chemical Subjects. By Professor S. P. Robbins, McGill Normal School.

On the date of the Report on the Geology of Wisconsin, noticed in this Journal, Vol. VI, p. 465.

Many of these papers combine great practical utility, with the scientific knowledge displayed in the manner in which the subjects have been handled. For example :—" Considerations relating to the Quebec Group, and the Upper Copper-bearing rocks of Lake Superior," by Sir W. E. Logan. " Notes on the History of Petroleum or Rock Oil," by Professor Hunt. " On the recent discoveries of Gold in Nova Scotia," by Principal Dawson. " On the Primitive Formations in Norway and in Canada, and their Mineral Wealth," by Mr. T. Macfarlane. (A series of exceedingly valuable papers.) " On the failure of the Apple Trees in the neighbourhood of Montreal," by Mr. John Archbold.—While others were of such a nature as to be of general interest to all Canadians; such as " Additional Notes on Aboriginal Antiquities found at Montreal," by Principal Dawson. " On the origin of the name of Canada," by Rev. Dr. Davies; and some others. But whatever may be the estimate formed, by those amongst whom we live, of the labours of this Society, and the proverb too often holds good that "a prophet hath no honour in his own country;" yet the *Natural History Society* of Montreal, is now a known and honoured Institution, not only on this Continent, but in England, in all parts of the Continent of Europe, and elsewhere. Besides its regular circulation, 50 copies of the *Canadian Naturalist* are distributed, on every issue of the Bi-monthly Numbers, amongst as many of the principal Scientific Societies throughout the world; and extracts therefrom are constantly being republished by them, in their own Journals and Periodicals, with most honourable mention of our contributions to the cause of Natural Science in general, and the illustration of Canadian Natural History and Geology in particular. I wish, also, to direct attention to our Museum, which, in its Zoological Department, and indeed I believe I may say, as a general collection, is second to none now existing in the Province; and which we are anxious to see made useful, both as a means of assisting the labours of students, and creating a taste for Natural Science in the public at large. There is one department of which I would make special mention, both on account of its own value, and also because it is only very recently that it has been placed in a condition to be at all easily accessible by those

seeking information from its stores. I allude to the *Herbarium*, respecting which I have received an interesting account from the Rev. A. F. Kemp, than whom there is no one amongst us better qualified to judge of its value, or describe its contents.

Some account of the Herbarium of the Natural History Society of Montreal.

" A Committee has been appointed to put this valuable Herbarium into such order as to render it henceforth more useful for the promotion of botanical research. Some progress has already been made in the work. It has been put into the hands of a gentleman well acquainted with the method adopted by the Botanical Society of Edinburgh in the preparation and arrangement of specimens. Less is known about the collection of dried plants, and less attention has been directed to it than its extent and value merit. It is understood that the late Dr. Holmes, whose Herbarium is one of the treasures of the McGill Museum, presented duplicates of most of his specimens, many years ago, to the Natural History Society. These form the original nucleus of our Herbarium. Additions have from time to time been made to it by other friends of the Society. Lady Dalhousie, who, while in Canada, was an enthusiastic botanist, presented a large collection of well prepared specimens of Canadian Flora, which it is understood forms part of the collection. The chief and by far the most valuable portion of the Herbarium, as well as the case in which it is preserved, was however bequeathed to the Society by the late Mr. Macrae, who devoted some years to the study and collection of North American Flora. For this purpose he travelled extensively in the Northern States of America and in Canada East. He devoted much time and care to the preparation of his collections, and has left them in admirable condition and preservation. They have all been determined in accordance with the system of the latest American botanists; and comprise several valuable specimens from the Herbaria of Carey and Gray. Mr. Macrae fell into ill health and was long an invalid. An enthusiast in the science of botany, he deserves honourable mention and remembrance. Although he published nothing to attract attention, he yet is entitled, considering the extent and beauty of his collection, to be named along with the distinguished Botanists of America. The collection should be entitled the *Macrae Herbarium.* If properly labelled and catalogued, it would form a good

basis for a complete illustration of North American Botany. It is hoped that before long, by the exertions of the Committee to whose care the Herbarium has been entrusted, it will be rendered easy of reference to the members of the Society, and that by a system of exchanges its lacunæ will be filled up."

"It is also worthy of notice that the Society has a considerable collection of Marine Algæ, carefully catalogued and determined, which might be useful to the Students of this department of Botany. The Society will be happy to receive additions to these collections from scientific friends."

The usual course of *Somerville* lectures were delivered during the last winter; as will be more fully noticed in the report of the Council, which will be read to you by-and-bye. I was only able to be present at two out of the six, having been absent from town when the rest were delivered, or else prevented by some unavoidable engagement elsewhere. But if the others were as interesting as those I heard, which I have every reason to believe they were, they will well have kept up the good name which the Society has earned in former years.

The first lecture, at which I was present, was that delivered by Rev. A. F. Kemp, "On minute forms of life, especially addressed to the young." And it was matter of much regret to me and many others, that he so rigidly confined himself as to time, that he could not make use of half the very beautiful diagrams, which he had so carefully prepared to illustrate his subject. The other lecture was by the Rev. E. Wood, "A popular account of the Durham Coal-fields, with a brief narrative of a visit underground." This was, I should think, one of the most popular of the whole course; both from the graphic description given of those subterraneous regions—which, however, I own seem to me much pleasanter to hear of than to explore—and also from the circumstance that just at the time of its delivery we had received from England the heart-rending intelligence of the terrible catastrophe at the Hartley Colliery; the nature of which the lecturer most fully explained with appropriate diagrams. I think then that in various ways the Society is endeavouring faithfully to accomplish the objects for which it was incorporated, and to aid in which it receives an annual grant from the Legislature. And some indication that it is at length beginning to be better appreciated by the citizens of Montreal, may be gathered from the fact that 87 new members have joined us during the last year, more than one-third as

many as our whole previous numbers. When I look back upon the state of the Society some ten years ago, at the time of my first becoming a member of it, when I think of the feeble efforts it was then making for the mere preservation of its actual existence, when I contemplate the names now on our list, both as to numbers, and, in so many instances, as to standing and well earned reputation, as men of science and learning, the good results of whose labours are acknowledged far and wide, wherever natural science is valued and cultivated, when I look at our present place of meeting with its well arranged museum, laboratory, library, and lecture room, when I see how and by whom I am now surrounded and supported, I begin with some confidence to realize the truth of the motto which the Society has adopted, and I feel that it is indeed becoming no idle boast to assert, "Tandem fit surculus arbor." And though our usefulness and progress are still very much crippled by the remaining debt due by the Society, incurred by erection of this building in which we are now assembled; yet I cannot but entertain a strong hope that, by the increasing support of our fellow-citizens, which it is our endeavour to merit by our labours, we shall, at no distant day be entirely relieved from this incumbrance.

Report of Council.

The period having arrived when it becomes the duty of your Council to lay before you the usual Annual Report, they have now the pleasure of presenting you their Report of progress during the past year, and such a statement of the affairs of the Society as they hope will meet with your entire approval.

The Society during the past year has steadily advanced and prospered. Many valuable and interesting papers have been read, the monthly meetings have been well attended, and the Somerville Course of Lectures delivered to large audiences. Important additions have been made to the Museum and the Library, the list of members has largely increased, and the amount of dues received from this source has improved the finances of the Society. The publication of the "Canadian Naturalist and Geologist" has been continued with increased efficiency, and its circulation much extended.

LECTURES.

The following Annual Free Course of Somerville Lectures was delivered under the auspices of the Society:

February 6th, 1862.—On the harmony resulting from apparent discords and anomalies in nature.—CHARLES ROBB, ESQ., C.E.

February 13th, 1862.—On the utility of birds to agriculture, and the desirability of endeavoring to prevent their destruction on the Island of Montreal.—ALFRED RIMMER, ESQ.

February 20th, 1862.—On minute forms of life, especially addressed to the young.—REV. A. F. KEMP.

February 29th, 1862.—" A popular account of the Durham coal fields, with a brief narrative of a visit underground."

REV. EDMOND WOOD, M.A.

March 6th, 1862.—On some relations of the mineral, vegetable and animal kingdoms.—DR. T. S. HUNT.

March 20th, 1862.—On the Geological History of a lump of coal.—DR. DAWSON.

MEMBERSHIP.

This department has been under the charge of a Committee of the Council of four members, whose labors have been most praiseworthy and successful.

The list of members compared with that of last year is as follows:—

	1860–61	1861–62
Life members, - - - - -	36	38
Ordinary members, - - - -	180	261

Eighty-seven ordinary members having been elected during the year, and two only having resigned, and two died. Two corresponding members only were elected. Two ordinary members of the Society, C. Dunkin, Esq., M.P.P., and H. J. Ibbotson, Esq., have been elected life members on account of very munificent donations of books to the library.

PAPERS READ.

During the year twenty-eight papers have been read at the monthly meetings, and the more important of them published in the "Naturalist." These papers have been more fully noticed in the President's address.

PUBLICATION OF THE "NATURALIST."

In connection with the system of exchanges with scientific journals of other countries, your Council have to remark that the papers published in the "Naturalist" have been extensively reproduced in other journals, and the reputation of this society, and

its journal extended and increased, and the "Naturalist" obtained a wider and larger circulation and a foremost place as one of the representatives of Canadian science, very many valuable exchanges have thereby been added to our library, which when carefully preserved and bound will largely increase the number of volumes in charge of the librarian.

To D. A. Poe, Esq., of the Editing Committee, to whom was entrusted the editorial supervision, as well as the members of the Editing Committee, the Society is indebted for their exertions and labors in connection with the "Naturalist."

MUSEUM AND LIBRARY.

The Reports of the Library Committee and of the Curator are herewith submitted. Very many valuable donations have been presented to the Society during the past year, both to the museum and to the library. There is still much to be done in the labelling and arrangement of the specimens in the museum; and it is hoped that this work will be pushed forward by our successors. The cabinet-keeper, Mr. Hunter, has assiduously attended to his duties, the interests of the Society and the care of the museum. The numerous additions to the latter have been carefully prepared and preserved by him.

GENERAL AFFAIRS.

The Council have to acknowledge with pleasure the receipt of the annual grant of $1000 cy., from the Government in aid of the Society. The financial affairs as detailed in the annexed Treasurer's Report are highly gratifying. The actual debt of the Society has been lessened about $300 cy., and all interest on the loans and the old accounts fully paid up. Negotiations to transfer the debt in mortgage, with a lesser rate of interest, are now nearly completed. There is every reason to hope that, by increased exertion, the burdensome debt now crippling the Society may in the coming year be decreased.

The notification of the monthly meetings is now made by circular to each member, and the charge for advertisements in the newspapers, which from the number of meetings formerly reached to a large sum, entirely done away with, and the attendance of members secured at little expense.

Petitions have been forwarded to the Legislature for legislative enactment for the protection of the smaller birds, similar to that which exists in other countries, and should action be therein taken

by the Legislature, great benefit will be conferred on the farmer and gardener. An act for the amendment of the constitution is now under the consideration of parliament, and, if passed, the efficiency of the Society will be thereby increased.

A committee of the members is now on deliberation concerning the "disease of the apple trees on the Island of Montreal," a subject of great and practical importance, and their report will be of great value to horticulturalists and to the Society.

From a review of the events of the past year, and the progress of the Society, your Council have every reason to believe that their ardent wishes for the increase of the prosperity and usefulness of the Society will be realized, and that the Society may meet with still greater success, and obtain that support from its members and the public to which it is justly entitled, much, very much depends upon the zeal and activity of the members, and if they would see the Society rank more prominently as a public institution, its debt liquidated, and its membership augmented, they too must assist. It is upon the subscription that we are to depend in a great measure for funds not only to meet the current expenses, but to pay the old debts, and enable the Society to engage in furthering the study of Natural History. Let the members feel that a certain amount of responsibility rests upon them. The Council acting in conjunction would find additional motives for zeal and activity, and in promoting the legitimate objects of the Society. They should feel that the members are auxiliaries in their labors, and that their valuable counsel and assistance is afforded. The Society then will surely realize its important position.

Montreal, 15th May, 1862.

List of Donations to the Museum.

Donors' Names.	Donations.
John Leeming, Esq.....	Specimen of a Bill-fish, (*Lepidosteus Huronensis.*)
James Ferrier, Jr., Esq..	Do. do.
Stanley C. Bagg, Esq...	Snuff-box of a Mandarin.
	Map of the Seceding States of America.
	Piece of Christ Church Cathedral Bell.
	Piece of Magnetic Wire from Sebastopol.
	Rock Specimen from Cape Diamond, C. E.
	Do. Sault-aux-Recollets.
Mr. William Hunter.....	Male Canada Porcupine, (*Hystrix dorsata.*)
	Nest of Indigo Bird, (*Spyzia Cyanea,*) 4 eggs.

List of Donations to the Museum.

Donors' Names.	Donations.
Mr. William Nivin......	Rice Bunting, *Dolichonyx oryzevora.*)
	Baltimore Creole, (*Icterus Baltimore.*)
	Red-winged Starling, (*Aglaius Phœniceus.*)
	Tyrant Fly-catcher, male and female, (*Muscicapa tyrannus.*)
	Yellow-billed Woodpecker, male and female, (*Picus varius.*)
	Common Blue-bird, female, (*Sialia Wilsonii.*)
John Leeming, Esq.....	Three Purple Grakles, two males and one female, (*Quiscalus versicolor.*)
	Red-winged Starling, (*Aglaius Phœniceus.*)
	Rice Bunting, (*Dolychonyx oryzivora.*)
	Purple Finch, (*Erythrospiza purpurea.*)
	Nest of Young King-fishers (7,) (*Alcedo alcyon.*)
	Common Crow, (*Corvus Americanus.*)
S. J. Lyman, Esq.	A pair of live Turtles for the Aquarium.
Alfred Baynes, Esq.....	A young female Fox, (*Vulpes fulvus.*)
Mr. John C. Struthers...	Common Tree Frog, (*Hyla versicolor,*) from Darlington, C. W.
	Specimens of Conglomerate from Hamilton, C. W.
Mr. Atcheson..........	Egg of the Great Northern Diver, or Loon, (*Colymbus glacialis.*)
	White-breasted Nest-hatch, (*Sitta Carolinensis.*)
F. D. Fulford, Esq......	Specimen of Garter Snake, (*Coluber sirtalis.*)
Mr. David............	Female Gos-Hawk, (*Falco palumbarius,*) from Three Rivers.
Mrs. Col. Denny........	kin of a Flamingo fro m Carthage.
Mrs. Harvey...........	A species of Lizard.
H. G. Vennor, Esq......	A species of Turtle from Constantinople.
George Barnston, Esq...	Three Eggs of the Spotted Sandpiper.
	Four Eggs of the White-throated Sparrow.
John D. McCord, Esq...	Garter-Snake and young, (*Coluber sirtalis.*)
Mr. William Hagar.....	Piece of the Cap of a Bell burnt by Confederates at Harper's Ferry.
Mr. J. C. Swanston.....	Coin of the reign of Queen Anne, 1703.
Mr. Rowe..............	Great Blue Heron, (*Ardea Herodias,*) from Norton Creek, C. E.
Mr. Thomas Swanston...	Specimen of Horned Frog.
Peter Redpath, Esq.....	" *Gorgonia pinnata* from California.
	" Cray-fish from Mammoth Cave, Virginia.
Mr. Charles Robb.......	Copper Beads and Shells of Purpura; Indian relics found near Brockville, C. W., with explanatory notice.
Thos. Savage, Esq......	Great Horned Owl, (*Bubo Virginiana,*) from Shefford, C. E.
A. F. Brown, Esq.......	Specimen of Fruit.
Mr. James Hempstead...	Collection of New Zealand War Implements.
Mr. G. H. Vennor.......	Salmon Trout from Lake Magog, C. E.
Dr. J. A. Crevier.......	A Turtle from Constantinople.
Mr. James Thomson.....	Pair of Gold Fishes for Aquarium.

List of Donations to the Museum.

Donors' Names.	Donations.
Mr. John Sheppard	Specimen of Scrub Pine.
	" Fungus.
John Leeming, Esq.....	Nine Busts and Statuettes.
	Three Porcelain Jugs and Vases.
Dr. Dawson...........	Collection of Plants from Mount Washington

List of Donations to the Library.

Donors' Names.	Names of Books.	
Official................	Canada Gazette.	Received regularly.
"	Journal of Education.	
The Publishers.........	Canadian Naturalist and Geologist.	
Exchange for Naturalist.	Canadian Journal, Toronto.	
	Annals of Botanical Society of Canada.	
	Proceedings of Lit. and Hist. Soc. Quebec.	
	Silliman's American Journal.	
	Journal Franklin Institute.	
	Proceedings of Essex Institute.	
	" Entomological Soc. of Phila.	
The Publishers.........	London Geologist.	
	" Technologist.	
	" Phytologist.	
	Journal of Society of Arts.	
	British American Journal.	
	Scientific American.	
	Academy of Arts and Sciences, Philadelphia, 5 volumes, and Nos. 329 to 884.	
Official................	Statutes of Canada, in English and French.	
	Historical Magazine, June, 1861.	
	Explication du Zodiaque, Caen, 1861.	
The Author...........	Les Oiseaux du Canada, par J. M. Lemoine.	
	Dundas, or Early Canadian History, by James Croil, Esq.	
	Pamphlets on *Sanguinaria Canadensis*, by Dr. Gibb.	
J. A. Perkins, Jr.......	Smithsonian Contributions for 1856.	
Smithsonian Ins., Washington	Do. do.	
Mr. Hammond.........	Pamphlets on Nat. Hist. Konigsberg.	
Royal Academy, Stockholm..............	Entomologiska Bidrag, P. III, 1859.	
Dr. Dawson...........	Calendar of McGill University.	
U. S. Patent Office, Washington	United States Patent Laws and Directions, 2 vols.	
	California Agricultural Soc. Jour., March to May, 1861.	

List of Donations to the Library.

Donors' Names.	Names of Books.
C. Dunkin, Esq., M.P.P.	19 vols. Natural History of State of New York, with the accompanying maps.
	Ray's Natural History.
S. L. Goodale, Esq......	Report of Maine Board of Agriculture, 1860.
Dr. Gibb, London......	Addresses of Presidents Geol. Soc. of London, 3 copies.
Jules Marcou, Esq......	Pamphlets on Taconic and Lower Silurian Rocks.
University of Norway...	Scientific Pamphlets, 1 book and 16 pamphlets.
Hon. East India Co., London...............	Magnetical and Meteorological Observations for 1859, Bombay Observatories, 9 pamphlets.
Geological Soc., Berlin..	8 pamphlets on Scientific Subjects.
John Leeming, Esq.....	Taylor's Statistics of Coal, 1 vol. 8vo.
	Bituminous Substances employed in arts, Philadelphia, 1855.
	Waddington's Visit to Ethiopia, London, 1822.
	Antiquities, &c., in St. Peter's, Westminster.
	6 vols. Statistique Général de la France.
	2 vols. Bibliothèque des Mémoires.
	1 vol. Algebra, M. Bourbon.
	5 vols. Chimie, Thenard.
	1 vol. Histoire des Etats Européens.
	1 " " de Moyen Age.
	2 vols. Œuvres de Me. la Duchesse de Duras.
	1 vol. Littérature et des Arts.
	4 vols. Mulray's Chemistry.
	2 vols. Wilkinson on Galvanism.
	2 vols. Outlines of Mineralogy and Geology.
	4 quarto vols. Life of James the First of England.

The Canadian Naturalist.

The *Canadian Naturalist* is sent to the following Institutions, and Societies:—

CANADA, ETC.

University College,...................Toronto.
Trinity College,..................... "
Canadian Institute.................... "
Knox College.......................... "
Victoria College,.....................Cobourg.
Queen's College,......................Kingston.
Botanical Society,.................... "
McGill College,.......................Montreal.
Bishop's College,.....................Lennoxville.
Laval University,.....................Quebec.
Literary and Historical Society.......... "
Natural History Society................St. John, N. B.

UNITED STATES.

Harvard College....................	Cambridge, Mass.
Amherst College......................	Amherst.
Yale College,........................	New Haven.
Natural History Society,...............	Boston.
American Acad. Sciences..............	"
Essex Institute,......................	Salem.
Lyceum of Natural History,............	New York.
Astor Library.........................	"
Academy of Natural Sciences,...........	Philadelphia.
Franklin Institute....................	"
American Philosophical Society.........	"
Smithsonian Institute,.................	Washington.
Academy of Science,..................	St. Louis.
University of Nashville,................	Tennessee.

GREAT BRITAIN.

Geological Society,....................	London.
Linnean Society,.....................	"
Royal Society,........................	"
Entomological Society,................	London.
Zoological Society,....................	"
Society of Arts,......................	"
Chemical Society.....................	"
Geological Survey of Great Britain.......	"
Botanical Society,....................	Edinburgh.
Royal Physical Society,...............	"
Royal Society,.......................	"
Royal Scottish Society of Arts,..........	"
Geological Society,....................	Dublin.
Royal Irish Academy,.................	"
Royal Society,.......................	"
Literary and Philosophical Society,......	Manchester.
Natural History Society,...............	Newcastle upon Tyne

CONTINENT OF EUROPE.

Société Géologique de France,..........	Paris, France.
Academy of Sciences..................	"
Académie des Sciences, Arts, &c.,.......	Dijon. "
L'Académie Royale des Sciences, etc.....	Lyons. "
Academia Car. Leop.,..................	Jena, Saxe Weimar.

Kaiserlichen Academie,................Vienna, Austria.
Im. Geological Institute................ "
Deutsches Geolog. Gesellschafft, ...Berlin, Prussia.
Koniglichen Akademie der Wissenschaften. " "
Koninklijke Akademie van Wetenschappen. Amsterdam.
Konigl. Gesellschaft der Wissenschaften...Gottingen.
Société Hollandaise des Sciences..........Haarlem.
Konigl. Sachs. Gesellschaft der Wissenschaften.........................Leipzig.
Société Imperiale des Naturalistes........Moscou.
Konigl. Bayerischen Akademie der Wissenchaften.........................Munich.

And to the following Periodicals:—

CANADA.

The Medical Journal,..................Montreal.
Journal of the Board of Arts............Toronto.

UNITED STATES.

Silliman's Journal,.........................New Haven.

GREAT BRITAIN.

Annals and Magazine of Natural History,..London.
The Geologist,...................... "
The Phytologist,...................... "
The Zoologist,........................ "
The Ibis,............................ "
The Technologist,.................... "
London, E. and D. Philosophical Magazine. "
Natural History Review,............... "
Microscopical Journal,................ "
Chemical News,...................... "
The Builder,........................ "
The Engineer,........................ "
The Gardeners' Chronicle,.............. "
Edinburgh New Philosophical Journal,...Edinburgh.

CONTINENT OF EUROPE.

Annales des Sciences Naturelles,.........Paris, France.
Archives de Musée,.................. " "
Allgemeine Deutsches Naturh. Zeitung,...Dresden, Saxony.

Archiv. fur Naturgeschichte by Weigman,.Berlin, Prussia.
Leopoldina,..........................Jena, Saxe Weimar.
Leonhard und Brohn Jahrbuch,.......Stutgardt, Wurtemburg.
Flora,..............................Ratisbon, Bavaria.

OFFICERS FOR 1862-3.

President—The Lord Bishop of Montreal and Metropolitan.

Vice-Presidents
- Sir W. E. Logan, LL.D., F.R.S.
- Principal Dawson, LL.D., F.R.S.
- Rev. A. F. Kemp.
- Mr. W. H. A. Davies.
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Library Committee—Messrs. J. C. Becket, H. Rose, Professor Cornish, Dr. Fenwick, and D. Mackay.

Editing Committee of the "Naturalist"—Mr. D. A. Poe, *Acting Editor;* Principal Dawson, Prof. T. S. Hunt, Mr. E. Billings, Professor Robins, W. H. Hingston, M. D., and Mr. John Leeming.

THE NATURAL HISTORY SOCIETY OF MONTREAL IN ACCOUNT WITH JAMES FERRIER, JUNR., TREASURER.

DR.

RECAPITULATION.

1861. May 1.		
Balance due the Treasurer,		$173 25
Cash paid,	Mr. Hunter's salary,	200 00
"	J. A. Perkins, Jr.	100 00
"	C. McCormick	46 20
"	Interest	318 00
"	for Fuel,	122 00
"	City Assessments	111 10
"	Water Rent	81 75
"	Gas Account	24 60
"	Insurance	38 00
"	Books and Binding	252 30
"	Advertising and Printing	148 16
"	Repairs and fixtures	67 48
"	Incidental expenses	35 90
Balance in Treasurer's hands		16 26
		$1735 00

CR.

RECAPITULATION.

1862. May. 1.	
By cash received for subscriptions and diplomas	$715 00
By cash received for admission fees to museum	20 00
By cash received for annual govern. grant	1000 00
	$1735 00

Montreal, 1st May, 1862.

JAMES FERRIER, JUNR.,
Treasurer N. H S.

MONTHLY METEOROLOGICAL REGISTER, ST. MARTINS, ISLE JESUS, CANADA EAST, (NINE MILES WEST OF MONTREAL,) FOR THE MONTH OF APRIL, 1862.

Latitude, 45 degrees 32 minutes North. Longitude, 73 degrees 36 minutes West. Height above the level of the Sea, 118 feet.

BY CHARLES SMALLWOOD, M.D., LL.D.

Day of Month.	Barometer—corrected and reduced to 32° F. (English inches.)			Temperature of the Air.—F.			Tension of Aqueous Vapour.			Humidity of the Atmosphere.			Direction of Wind.			Horizontal Movement in 24 hours. In miles.	OZONE. Mean amount of, in tenths.	RAIN. Amount of, in inches.	SNOW. Amount of, in inches.	WEATHER, CLOUDS, REMARKS, &c. &c. [A cloudy sky is represented by 10, a cloudless one by 0.]		
	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.					6 a. m.	2 p. m.	10 p. m.
1	30.149	30.179	30.254	38.2	43.9	34.1	.177	.218	.156	.85	.76	.79	E. S. E.	S. S. E.	S. S. W.	0.30	1.6	......	......	Cirr. Str. 4.	Cu. Str. 10.	Cu. Str. 9. Hail & rain 7.19 pm.
2	290	114	29.927	32.1	51.4	33.1	.143	.298	.168	.79	.78	.89	S. S. E.	S. S. E.	S. by W.	118.10	3.0	Inapp.	......	Fog.	" 4.	Clear.
3	29.773	29.824	909	40.1	47.2	35.8	.203	.298	.177	.82	.92	.84	W. S. W.	W. S. W.	W.	409.90	2.5	0.014	......	Cirr. Str. 10.	Rain.	Rain.
4	30.210	30.158	30.251	22.0	42.2	27.9	.084	.177	.111	.71	.66	.75	W.	S. by W.	S. W.	233.60	1.9	......	......	Clear.	Clear.	Clear. Zodiacal Light Bright.
5	109	29.779	29.770	17.1	20.2	27.4	.063	.142	.129	.67	.88	.88	N. E. by E.	S. S. E.	W. S. W.	255.60	2.5	......	3.70	Clear.	Snow.	Cu. Str. 10.
6	29.861	897	30.104	39.1	34.6	26.2	.139	.126	.111	.78	.65	.81	S. S. W.	W. by N.	W. N. W.	122.70	1.5	......	......	C. C. Str. 8.	Clear.	C. Cum. 4.
7	30.228	30.221	235	11.6	36.4	15.4	.051	.149	.056	.72	.71	.64	W. S. W.	W. S. W.	S. S. E.	214.80	9.5	......	......	Clear.	"	Clear.
8	196	144	165	5.1	44.3	18.7	.041	.196	.953	.74	.68	.75	N. E.	E.	S. S. W.	42.20	0.5	......	......	"	Cirr. Cum. 4.	"
9	103	009	101	19.4	41.1	24.3	.054	.190	.094	.78	.74	.73	E.	N. N. E.	N. N. E.	105.90	1.5	......	......	Clear.	Clear.	"
10	145	345	277	14.7	52.4	36.7	.042	.282	.134	.62	.73	.85	N. E. by E.	S. E. by E.	S. E.	172.00	1.5	......	......	"	" Inp. S. H. 3.30.	C. C. Str 6.
11	319	400	407	22.6	54.0	31.9	.095	.398	.128	.78	.74	.76	N. E. by E.	S. E. by E.	S. E. by E.	86.50	0.8	......	......	"	"	Clear.
12	378	367	344	26.2	58.9	35.2	.111	.342	.177	.81	.78	.85	N. E.	S. W.	S. by W.	118.40	0.5	......	......	"	"	"
13	250	241	227	30.9	56.3	35.6	.134	.315	177	.82	.71	.85	N. E. by E.	S. S. E.	S. S. E.	0.20	9.5	......	......	"	"	"
14	201	199	241	24.1	57.4	38.9	.109	.381	.188	.79	.81	.87	N. E. by E.	S. E.	S. E. by E.	2.00	1.0	......	......	"	Cu. Str. 4.	C. C. Str. 8.
15	398	524	351	37.2	51.7	39.8	.199	.298	.210	.90	.79	.86	S. S. E.	S. E.	S. E. by E.	1.10	1.0	Inapp.	......	Slight Rain.	C. C. Str. 4.	Clear. Faint Au. Bor.
16	279	183	110	36.5	61.2	44.2	.191	.442	.265	.90	.83	.92	E. by S.	S. E. by E.	E. S. E.	5.11	1.5	......	......	Clear.	Cirr. 4.	Cu. Str. 9.
17	091	948	29.898	48.6	66.4	48.1	.303	.502	.310	.89	.78	.92	E. S. E.	S. S. W.	S. by W.	56.99	9.5	......	......	C. C. Str. 9.	" 4.	Cirr. 2. Zodiacal Light.
18	29.997	29.883	750	40.5	66.1	42.0	.218	.219	.244	.88	.87	.81	W. by N.	W. by N.	S. W. by S.	30.89	1.6	0.161	......	Fog.	C. C. Str. 4.	Rain.
19	824	954	30.002	41.1	46.1	39.9	.212	.258	.210	.83	.81	.86	W.	W.	W.	344.50	2.0	......	......	C. Cum. 6.	Cu. Str. 8.	Cu. Str. 10.
20	30.007	30.075	151	38.4	50.0	39.7	.186	.299	.195	.31	.82	.82	W. by S.	S. W.	S. by W.	66.30	9.6	......	......	Clear.	Clear.	Clear. Zodiacal Light Bright.
21	097	29.924	29.960	34.1	52.9	41.2	.162	.308	.235	.84	.79	.91	E. S. E.	S. E.	S. E.	45.20	0.5	......	......	"	Cu. Str. 10.	Rain.
22	29.698	498	458	38.9	49.9	44.6	.214	.297	.282	.95	.92	.96	N. N. E.	N. E. by E.	S. E.	139.20	2.5	0.220	......	Cu. Str. 10.	C. C. Str. 10.	Cu. Str. 10.
23	464	620	820	40.1	43.1	29.9	.210	.222	.129	.88	.83	.84	W. S. W.	S. W.	W. by N.	317.60	1.9	......	......	" 8.	C. Cirr. 4.	C. C. Str. 8.
24	861	937	30.042	26.1	32.3	32.9	.111	.143	.149	.81	.79	.84	N. W.	W. S. W.	W. by N.	456.80	0.6	......	......	" 4.	Cu. Str. 10.	Clear.
25	30.164	30.139	186	24.7	60.1	33.6	.105	.290	.149	.81	.80	.84	W. N. W.	S. S. W.	S. S. W.	122.90	1.0	......	......	Clear.	Clear.	"
26	340	323	364	31.1	57.6	39.9	.158	.372	.195	.89	.78	.82	N. E. by E.	E. S. E.	S. E. by E.	32.90	1.5	......	......	C. Cu. 4.	"	"
27	391	301	269	32.1	62.7	42.1	.149	.422	.244	.84	.75	.91	N. E. by E.	N. E. by E.	N. E. by E.	16.80	1.0	......	......	Clear.	C. C. Str. 4.	Cu. Str. 10.
28	101	059	080	44.6	45.9	43.6	.282	.276	.271	.96	.92	.93	E. S. E.	S. S. E.	E. N. E.	112.90	2.5	Inapp.	......	Rain.	Cu. Str. 10.	Rain.
29	079	020	021	49.1	59.2	40.1	.225	.380	.219	.91	.76	.86	E. S. E.	S. by E.	S. W.	53.70	2.0	......	......	Cu. Str. 10.	" 4.	Clear. Faint Aur. Bor.
30	998	021	112	42.1	65.2	47.0	.228	.499	.305	.87	.81	.93	S.	S. W. by S.	S. E.	75.99	1.0	......	......	C. C. Str. 4.	Clear.	"

REPORT FOR THE MONTH OF MAY, 1862.

Day of Month.	Barometer—corrected and reduced to 32° F. (English inches.)			Temperature of the Air.—F.			Tension of Aqueous Vapour.			Humidity of the Atmosphere.			Direction of Wind.			Horizontal Movement in 24 hours. In miles.	OZONE. Mean amount of	RAIN. Amount of, in inches.	SNOW. Amount of, in inches.	WEATHER, CLOUDS, REMARKS, &c., &c. [A cloudy sky is represented by 10, a cloudless one by 0.]		
	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.					6 a. m.	2 p. m.	10 p. m.
1	30.061	30.127	30.091	42.6	50.0	43.7	.237	.302	.248	.87	.82	.88	N. E. by E.	N. E. by E.	N. E. by E.	107.60	2.0	0.133	......	C. C. Str. 4.	Rain.	Rain.
2	29.954	29.821	29.818	40.4	49.1	45.3	.225	.322	.300	.99	.92	1.00	N. E. by E.	N. E. by E.	N. E. by E.	185.90	6.9	1.576	......	Rain.	"	"
3	819	829	845	44.2	64.2	52.1	.248	.464	.334	.96	.77	.86	S. S. E.	S. W.	S. E.	89.90	3.9	Inapp.	......	Cu. Str. 10.	C. C. Str. 8.	C. C. Str. 4.
4	795	733	772	46.2	58.8	46.7	.262	.385	.280	.84	.84	.88	S. W.	S. W.	S. S. W.	147.59	1.9	......	......	C. C. Str. 4.	Cu. Str. 8.	Cu. Str. 2.
5	694	701	783	42.1	68.4	50.2	.244	.246	.309	.91	.91	.85	S. by W.	S. W.	S. W.	125.80	1.9	Inapp.	......	Rain.	" 4.	C. C. Str. 4.
6	600	343	454	39.7	61.9	48.5	.210	.436	.262	.86	.89	.84	W.	W.	N. by W.	196.00	2.0	......	......	Clear.	C. C. Str. 4.	Clear. Faint Aurora Borealis.
7	487	559	672	31.1	40.9	39.1	.155	.235	.195	.69	.91	.92	N. E. by E.	N. N. E.	N. N. W.	112.30	4.9	......	.291	Snow.	Thaw.	Cu. Str. 6.
8	779	774	680	36.1	55.7	51.1	.177	.379	.315	.85	.84	.89	N. N. E.	N. N. E.	S. by E.	192.80	2.0	......	......	Cu. Str. 10.	Cirr. 4.	Clear.
9	601	394	807	46.3	67.1	56.9	.269	.556	.370	.88	.84	.84	W. S. W.	S. S. W.	W.	241.40	1.5	......	......	" 10. dis.thu.	C. Cirr. 4.	C. C. Str. 4.
10	434	549	754	49.7	68.2	43.9	.299	.288	.209	.82	.65	.75	N. N. W.	S. by W.	N. W.	347.40	1.5	......	......	Clear.	Cu. Str. 8.	Clear.
11	885	885	972	34.1	66.4	48.8	.158	.438	.242	.89	.68	.74	W. by N.	N. by W.	S. S. W.	297.70	1.5	......	......	"	Clear.	Cu. Str. 4.
12	884	710	712	46.4	73.6	59.8	.262	.351	.403	.84	.44	.79	S. S. W.	N. N. E.	S. W.	165.10	2.9	......	......	Cu. Str. 10.	Hazy.	Hazy.
13	752	744	836	46.4	80.1	47.0	.262	.374	.256	.84	.73	.81	S. W.	S. by W.	S. by W.	80.50	2.9	Inapp.	......	" 10.	Clear.	Clear.
14	834	862	876	47.4	60.1	57.9	.232	.262	.378	.73	.51	.81	N. E.	E. S. E.	S. S. E.	53.60	1.5	......	......	Clear.	"	Cu. Str. 4.
15	918	859	903	51.1	84.3	54.0	.296	.923	.471	.80	.79	.81	S.	S.	S.	71.89	1.9	......	......	"	"	" Meteor S. 8 p. m.
16	917	692	800	60.1	87.4	64.8	.462	.928	.458	.82	.72	.75	S.	S.	S. by E.	107.30	1.0	......	......	"	"	C. Cum. 4.
17	892	736	648	58.9	88.1	67.4	.423	.915	.556	.88	.69	.83	S.	S.	S. by W.	59.10	1.9	......	......	"	"	Clear.
18	593	572	438	69.4	91.9	69.1	.345	1.939	.599	.78	.75	.85	S. by W.	S. by W.	S. by W.	181.99	1.5	......	......	"	Cu. Str. 4.	Cu. Str. 2.
19	414	464	602	47.2	58.3	49.0	.289	416	.253	.88	.85	.74	W. S. W.	W. S. W.	W. S. W.	478.10	2.6	Inapp.	......	Cu. Str. 10. dis.thu.	" 4.	" 8.
20	894	856	906	40.1	63 2	48.2	.169	.448	.269	.74	.77	.78	N. W.	W. by S.	W. S. W.	89.72	1.9	......	......	Clear.	Clear.	Clear.
21	30.001	918	740	44.7	69.5	84.2	.292	.338	.362	.71	.65	.87	S. S. E.	S. E.	S. E.	118.80	3.5	0 680	......	C. C. Str. 6.	Rain.	Cu. Str. 10.
22	29.628	782	789	41.1	68.4	52.1	.235	.358	.334	.91	.73	.88	S. S. W.	S. S. W.	W. S. W.	376.90	3.0	0 338	......	C. C. Str. 10.	Cu. Str. 10.	Clear.
23	601	748	693	56.1	62.9	47.9	.391	.363	.249	.87	.84	.77	W. S. W.	W. N. W.	N. by W.	139.11	1.6	Inapp.	......	Cu. Str. 10.	Clear.	"
24	980	876	899	38.2	55.9	58.3	.165	.288	.334	.72	.65	.82	N.W. by W.	W.	S.	162.20	1.5	......	......	Clear Frost.	Str. 4.	"
25	856	827	816	47.2	65.0	54.0	.197	.427	.315	.78	.71	.83	S. by W.	W. by S.	W. S. W.	152.00	1.5	......	......	"	Cu. Str. 4.	C. C. Str. 4.
26	868	849	747	47.0	67.1	55.3	.256	.425	.328	.81	.64	.77	N. E. by E.	S. S. W.	N. E. by E.	162.40	1.5	......	......	C. C. Str. 6.	C. C. Str. 4.	Cu. Str. 10.
27	621	582	521	50.9	80.9	69.9	.309	.684	.419	.85	.87	.80	E. S. E.	S. E. by E.	E. S. E.	225.50	2.0	Inapp.	......	Cu. Cirr. 10.	C. Cirr. 4.	" 10.
28	630	606	617	54.2	81.3	48.8	.362	.383	.229	.87	.71	.69	S. S. E.	S. W.	W. S. W.	298.20	1.0	......	......	C. C. Str. 10.	Cu. Str. 4.	Clear.
29	660	689	714	44.4	67.2	55.3	.215	.425	.321	.79	.64	.74	W. N. W.	W. by N.	W. by N.	243.39	1.9	......	......	Clear.	Clear.	"
30	451	580	751	39.1	70.4	50.2	.189	.449	.309	.77	.81	.85	S. S. E.	S. S. E.	S. S. E.	9.39	1.0	......	......	"	"	" Au. Borealis.
31	702	667	704	46.9	77.9	57.9	.238	.658	.372	.77	.67	.78	E. S. E.	S. S. W.	S. S. E.	9.90	1.5	......	......	"	"	"

REMARKS FOR APRIL, 1862.

Barometer....... Highest, the 11th day, 30·407 inches. Lowest, the 23rd day, 29.464 " Monthly Mean, 30.974 day, " " Range, 9.843 "

Thermometer... Highest, the 17th day, 66° 4. Lowest, the 8th day,—5° 1. Monthly Mean, 39° 06. Monthly Range, 81° 3.

Greatest intensity of the Sun's rays, 82° 2.
Lowest point of Terrestrial radiation,—5° 9.
Mean of Humidity, .816.
Snow fell on 1 day, amounting to 3.70 inches, it was snowing 6 hours 9.5 minutes.
Rain fell on 6 days amounting to 0.395 inches it was raining 12 hours 13 minutes.

Most prevalent wind, E. S. E.
Least prevalent wind, the S.
Most windy day the 24th day, mean miles per hour, 19.03.
Least windy day the 13th day, mean miles per hour, 0.00.
Aurora Borealis visible on 21 nights.
Zodiacal Light bright and well defined.
The Electrical state of the Atmosphere has indicated very feeble intensity.
Fringilla Melodia. Song Sparrow. (*Rossignol* French) first heard on 8 day.
Swallows. *Hirundo Rufa* 1st seen 20th day.
Wild geese. *Anser Canadensis*, 1st seen flying N. 26th day.
Frogs *Rana fontinalis*, 1st heard 23th day.
Thermometer in ground 18 inch deep 44°.

REMARKS FOR MAY, 1862.

Barometer. ...... Highest, the 1st day, 30.129 inches. Lowest, the 6th day, 29.343 " Monthly Mean, 29.738 " Monthly Range, 0.784 "

Thermometer. Highest, the 8th day, 91° 0. Lowest, the 24th day, 28° 2. Monthly Mean, 54° 61. Monthly Range, 62° 9.

Greatest intensity of the Sun's rays, 98° 2.
Lowest point of Terrestrial radiation,—24° 7.
Mean of humidity, ·786.—Amount of Evaporation, 3.61 inches.
Rain fell on 11 days, amounting to 2.725 inches; it was raining 34 hours and 45 minutes and was accompanied by thunder on 2 days.
Amount of Evaporation 3 61 inches.

Snow fell on 1 day amounting to 2·91 inches; it was snowing 5 hours and 29 minutes.
Most prevalent wind, S. W.
Least prevalent wind, N. by W.
Most windy day, the day; mean miles per hour, 19,97.
Least windy day, the day; Calm.
Aurora Borealis visible on 2 nights.
The Electrical state of the Atmosphere has indicated moderate intensity.
Temperature of the ground 18 inches deep 61.° 9.

Errata in last No. Reports of January, February and March, for 1861, *read* 1862.

THE

CANADIAN

NATURALIST AND GEOLOGIST.

VOL. VII. AUGUST, 1862. No. 4.

ARTICLE XXII.—*A Lecture on Force, delivered before the Royal Institution of Great Britain on the 6th of June, 1862, by* PROF. JOHN TYNDAL, F.R.S.*

The existence of the International Exhibition suggested to our Honorary Secretary the idea of devoting the Friday evenings after Easter of the present year to discourses on the various agencies on which the material strength of England is based. He wished to make iron, coal, cotton, and kindred matters, the subjects of these discourses; opening the series by a discourse on the Great Exhibition itself; and he wished me to finish the series by a discourse on Force in general. For some months I thought over the subject at intervals, and had devised a plan of dealing with it; but three weeks ago I was induced to swerve from this plan for reasons which shall be made known towards the conclusion of the discourse.

We all have ideas more or less distinct regarding force; we know in a general way what muscular force means, and each of us would less willingly accept a blow from a pugilist than have his ears boxed by a lady. But these general ideas are not now sufficient for us; we must learn how to express numerically the exact mechanical value of the two blows; this is the first point to be cleared up.

* From the L. E. and D. Philosophical Magazine for July, 1862.

[A sphere of lead weighing one pound was suspended at a height 16 feet above the theatre floor. It was liberated, and fell by gravity. The weight required exactly a second to fall to the earth from that elevation; and the instant before it touched the earth, it had a velocity of 32 feet a second. That is to say, if at that instant the earth were annihilated, and its attraction annulled, the weight would proceed through space at the uniform velocity of 32 feet a second.]

Suppose that instead of being pulled down by gravity, the weight is cast upward in opposition to the force of gravity, with what velocity must it start from the earth's surface in order to reach a height of 16 feet? With a velocity of 32 feet a second. This velocity imparted to the weight by the human arm, or by any other mechanical means, would carry the weight up to the precise height from which it had fallen.

Now, the lifting of the weight may be regarded as so much mechanical work. I might place a ladder against a wall, and carry the weight up a height of 16 feet; or I might draw it up to this height by means of a string and pulley, or I might suddenly jerk it up to a height of 16 feet. The amount of work done in all these cases, as far as the raising of the weight is concerned, would be absolutely the same. The absolute amount of work done depends solely upon two things: first of all, on the quantity of matter that is lifted; and secondly, on the height to which it is lifted. If you call the quantity or mass of matter m, and the height through which it is lifted h, then the product of m into h, or mh, expresses the amount of work done.

Supposing, now, that instead of imparting a velocity of 32 feet a second to the weight, we impart twice this speed, or 64 feet a second. To what height will the weight rise? You might be disposed to answer, "To twice the height:" but this would be quite incorrect. Both theory and experiment inform us that the weight would rise to four times the height; instead of twice 16, or 32 feet, it would reach four times 16, or 64 feet. So also, if we treble the starting velocity, the weight would reach nine times the height; if we quadruple the speed at starting, we attain sixteen times the height. Thus, with a velocity of 128 feet a second at starting, the weight would attain an elevation of 256 feet. Supposing we augment the velocity of starting seven times, we should raise the weight to 49 times the height, or to an elevation of 784 feet.

Now the work done—or, as it is sometimes called the *mechanical effect*—as before explained, is proportional to the height, and as a double velocity gives four times the height, a treble velocity nine times the height, and so on, it is perfectly plain that the mechanical effect increases as the square of the velocity. If the mass of the body be represented by the letter m, and its velocity by v, then the mechanical effect would be represented by $m v^2$. In the case considered, I have supposed the weight to be cast upward, being opposed in its upward flight by the resistance of gravity; but the same holds true if I send the projectile into water, mud, earth, timber, or other resisting material. If, for example, you double the velocity of a cannon-ball, you quadruple its mechanical effect. Hence the importance of augmenting the velocity of a projectile, and hence the philosophy of Sir William Armstrong in using a 50 pound charge of powder in his recent striking experiments.

The measure then of mechanical effect is the mass of the body multiplied by the square of its velocity.

Now, in firing a ball against a target, the projectile, after collision, is often found hissing hot. Mr. Fairbairn informs me that in the experiments at Shoeburyness it is a common thing to see a flash of light, even in broad day, when the ball strikes the target. And if I examine my lead weight after it has fallen from a height, I also find it heated. Now, here experiment and reasoning lead us to the remarkable law that the amount of heat generated, like the mechanical effect, is proportional to the product of the mass into the square of the velocity. Double your mass, other things being equal, and you double your amount of heat; double your velocity, other things remaining equal, and you quadruple your amount of heat. Here then we have common mechanical motion destroyed and heat produced. I take this violin bow and draw it across this string. You hear the sound. That sound is due to motion imparted to the air, and to produce that motion a certain portion of the muscular force of my arm must be expended. We may here correctly say, that the mechanical force of my arm is converted into music. And in a similar way we say that the impeded motion of our descending weight, or of the arrested cannon-ball is converted into heat. The mode of motion changes, but it still continues motion; the motion of the mass is converted into a motion of the atoms of the mass; and these small motions communicated to the nerves, produce the

sensation which we call heat. We, moreover, know the amount of heat which a given amount of mechanical force can develope. Our lead ball, for example, in falling to the earth generated a quantity of heat sufficient to raise the temperature of its own mass three-fifths of a Fahrenheit degree. It reached the earth with a velocity of thirty-two feet a second, and forty times this velocity would be a small one for a rifle bullet. Multiplying three-fifths by the square of forty we find that the amount of heat developed by collision with the target would, if wholly concentrated in the lead, raise its temperature 960 degrees. This would be more than sufficient to fuse the lead. In reality, however, the heat developed is divided between the lead and the body against which it strikes; nevertheless, it would be worth while to pay attention to this point, and to ascertain whether rifle bullets do not, under some circumstances, show signs of fusion.

From the motion of sensible masses, by gravity and other means, the speaker passed to the motion of atoms towards each other by chemical affinity. A collodion balloon, filled with a mixture of chlorine and hydrogen, was hung in the focus of a parabolic mirror, and in the focus of a second mirror, twenty feet distant, a strong electric light was suddenly generated. The instant the light fell upon the balloon the atoms within it fell together with explosion, and hydrochloric acid was the result. The burning of charcoal in oxygen is an old experiment, but it has now a significance beyond what it used to have; we now regard the act of combination on the part of the atoms of oxygen and coal, exactly as we regard the clashing of a falling weight against the earth. And the heat produced in both cases is referable to a common cause. This glowing diamond, which burns in oxygen as a star of white light, glows and burns in consequence of the falling of the atoms of oxygen against it. And could we measure the velocity of the atoms when they clash, and could we find their number and weight, multiplying the mass of each atom by the square of its velocity, and adding all together, we should get a number representing the exact amount of heat developed by the union of the oxygen and carbon.

Thus far we have regarded the heat developed by the clashing of sensible masses and of atoms. Work is expended in giving motion to these atoms or masses, and heat is developed. But we reverse this process daily, and by the expenditure of heat execute work. We can raise a weight by heat; and in this agent we

possess an enormous store of mechanical power. This pound of coal, which I hold in my hand, produces by its combination with oxygen an amount of heat, which, if mechanically applied, would suffice to raise a weight of one hundred lbs. to a height of twenty miles above the earth's surface. Conversely, one hundred pounds falling from a height of twenty miles, and striking against the earth, would generate an amount of heat equal to that developed by the combustion of a pound of coal. Wherever work is done by heat, heat disappears. A gun which fires a ball is less heated than one which fires blank cartridge. The quantity of heat communicated to the boiler of a working steam-engine is greater than which could be obtained from the re-condensation of the steam after it had done its work; and the amount of work performed is the exact equivalent of the amount of heat lost. Mr. Smyth informed us in his interesting discourse, that we dig annually 84 millions of tons of coal from our pits. The amount of mechanical force represented by this quantity of coal seems perfectly fabulous. The combustion of a single pound of coal, supposing it to take place in a minute, would be equivalent to the work of 300 horses; and if we suppose 108 millions of horses working day and night, with unimpaired strength, for a year, their united energies would enable them to perform an amount of work just equivalent to that which the annual produce of our coal-fields would be able to accomplish.

Comparing with ordinary gravity the energy of the force with which oxygen and carbon unite together, the chemical affinity seems almost infinite. But let us give gravity fair play: let us permit it to act throughout its entire range. Place a body at such a distance from the earth that the attraction of the earth is barely sensible, and let it fall to the earth from this distance. It would reach the earth with a final velocity of 36,747 feet in a second; and on collision with the earth the body would generate about twice the amount of heat generated by the combustion of an equal weight of coal. We have stated that by falling through a space of sixteen feet, our lead bullet would be heated three-fifths of a degree; but a body falling from an infinite distance has already used up 1,299,999 parts out of 1,300,000 of the earth's pulling power, when it has arrived within 16 feet of the surface; in this space only $\frac{1}{1300000}$ths of the whole force is exerted.

Let us now turn our thoughts for a moment from the earth to-

wards the sun. The researches of Sir John Herschel and Mr Pouillet have informed us of the annual expenditure of the sun as regards heat; and by an easy calculation we ascertain the precise amount of the expenditure which falls to the share of our planet. Out of 2300 million parts of light and heat the earth receives one. The whole heat emitted by the sun in a minute would be competent to boil 12,000 millions of cubic miles of ice-cold water. How is this enormous loss made good? Whence is the sun's heat derived, and by what means is it maintained? No combustion, no chemical affinity with which we are acquainted would be competent to produce the temperature of the sun's surface. Besides, were the sun a burning body merely, its light and heat would assuredly speedily come to an end. Supposing it to be a solid globe of coal, its combustion would only cover 4600 years of expenditure. In this short time it would burn itself out. What agency can then produce the temperature and maintain the outlay? We have already regarded the case of a body falling from a great distance towards the earth, and found that the heat generated by its collision would be twice that produced by the combustion of an equal weight of coal. How much greater must be the heat developed by a body falling towards the sun! The maximum velocity with which a body can strike the earth is about seven miles in a second; the maximum velocity with which it can strike the sun is 390 miles in a second. And as the heat developed by the collision is proportional to the square of the velocity destroyed, an asteroid falling into the sun with the above velocity, would generate about 10,000 times the quantity of heat generated by the combustion of an asteroid of coal of the same weight. Have we any reason to believe that such bodies exist in space, and that they may be raining down upon the sun? The meteorites flashing through the air are small planetary bodies, drawn by the earth's attraction, and entering our atmosphere with planetary velocity. By friction against the air they are raised to incandescence, and caused to emit light and heat. At certain seasons of the year they shower down upon us in great numbers. In Boston 240,000 of them were observed in nine hours. There is no reason to suppose that the planetary system is limited to "vast masses of enormous weight;" there is every reason to believe that space is stocked with smaller masses, which obey the same laws as the large ones. That lenticular envelope which surrounds the sun, and which is known to astron-

omers as the zodiacal light, is probably a cloud of meteors; and moving, as they do, in a resisting medium they must continually approach the sun. Falling into it, they would be competent to produce the heat observed, and this would constitute a source from which the annual loss of heat would be made good. The sun, according to this hypothesis, would be continually growing larger; but how much larger? Were our moon to fall into the sun it would develope an amount of heat sufficient to cover one or two years' loss; and were our earth to fall into the sun a century's loss would be made good. Still, our moon and our earth, if distributed over the surface of the sun, would utterly vanish from perception. Indeed, the quantity of matter competent to produce the necessary effect would, during the range of history, produce no appreciable augmentation in the sun's magnitude. The augmentation of the sun's attractive force would be more appreciable. However this hypothesis may fare as a representant of what is going on in nature, it certainly shows how a sun might be formed and maintained by the application of known thermo-dynamic principles.

Our earth moves in its orbit with a velocity of 68,040 miles an hour. Were this motion stopped, an amount of heat would be developed sufficient to raise the temperature of a globe of lead of the same size as the earth, 384,000° of the centigrade thermometer. It has been prophesied that "the elements shall melt with fervent heat." The earth's own motion embraces the conditions of fulfilment; stop that motion, and the greater part, if not the whole of her mass, would be reduced to vapour. If the earth fell into the sun, the amount of heat developed by the shock would be equal to that developed by the combustion of 6435 earths of solid coal.

There is one other consideration connected with the permanence of our present terrestrial conditions, which is well worthy of our attention. Standing upon one of the London bridges, we observe the current of the Thames reversed, and the water poured upward twice a-day. The water thus moved, rubs against the river's bed and sides, and heat is the consequence of this friction. The heat thus generated is in part radiated into space, and then lost, as far as the earth is concerned. What is it that supplies this incessant loss? The earth's rotation. Let us look a little more closely at the matter. Imagine the moon fixed, and the earth turning like a wheel from west to east in its diurnal rota-

tion. Suppose a high mountain on the earth's surface; on approaching the moon's meridian, that mountain is, as it were, laid hold of by the moon, and forms a kind of handle by which the earth is pulled more quickly round. But when the meridian is passed, the pull of the moon on the mountain would be in the opposite direction, it now tends to diminish the velocity of rotation as much as it previously augmented it; and thus the action of all fixed bodies on the earth's surface is neutralized. But suppose the mountain to lie always to the east of the moon's meridian, the pull then would be always exerted against the earth's rotation, the velocity of which would be diminished in a degree corresponding to the strength of the pull. The tidal wave occupies this position—it lies always to the east of the moon's meridian, and thus the waters of the ocean are in part dragged as a brake along the surface of the earth; and as a brake they must diminish the velocity of the earth's rotation. The diminution, though inevitable, is, however, too small to make itself felt within the period over which observations on the subject extend. Supposing, then, that we turn a mill by the action of the tide, and produce heat by the friction of the millstones; that heat has an origin totally different from the heat produced by another mill which is turned by a mountain stream. The former is produced at the expense of the earth's rotation; the latter at the expense of the sun's radiation.

The sun, by the act of vaporisation, lifts mechanically all the moisture of our air. It condenses and falls in the form of rain, —it freezes and falls as snow. In this solid form it is piled upon the Alpine heights, and furnishes materials for the glaciers of the Alps. But the sun again interposes, liberates the solidified liquid, and permits it to roll by gravity to the sea. The mechanical force of every river in the world, as it rolls towards the ocean, is drawn from the heat of the sun. No streamlet glides to a lower level without having been first lifted to the elevation from which it springs, by the mighty power of the sun. The energy of winds is also due entirely to the sun; but there is still another work which he performs, and his connection with which is not so obvious. Trees and vegetables grow upon the earth, and when burned they give rise to heat, and hence to mechanical energy. Whence is this power derived? You see this oxyd of iron, produced by the falling together of the atoms of iron and oxygen; here also is a transparent gas which you cannot now see—car-

bonic acid gas—which is formed by the falling together of carbon and oxygen. These atoms thus in close union resemble our lead weight while resting on the earth; but I can wind up the weight and prepare it for another fall, and so these atoms can be wound up, separated from each other, and thus enabled to repeat the process of combination. In the building of plants carbonic acid is the material from which the carbon of the plant is derived; and the solar beam is the agent which tears the atoms asunder, setting the oxygen free, and allowing the carbon to aggregate in woody fibre. Let the solar rays fall upon a surface of sand; the sand is heated, and finally radiates away as much heat as it receives; let the same beams fall upon a forest, the quantity of heat given back is less than the forest receives, for the energy of a portion of the sunbeams is invested in building up the trees, in the manner indicated. Without the sun the reduction of the carbonic acid cannot be effected, and an amount of sunlight is consumed exactly equivalent to the molecular work done. Thus trees are formed; thus the cotton, on which Mr. Bazley discoursed last Friday, is formed. I ignite this cotton, and it flames; the oxygen again unites with its beloved carbon; but an amount of heat equal to that which you see produced by its combustion was sacrificed by the sun to form that bit of cotton.

But we cannot stop at vegetable life, for this is the source, mediate or immediate, of all animal life. The sun severs the carbon from its oxygen; the animal consumes the vegetable thus formed, and in its arteries a reunion of the severed elements takes place, and produces animal heat. Thus, strictly speaking, the process of building a vegetable is one of winding up; the process of building an animal is one of running down. The warmth of our bodies, and every mechanical energy which we exert, trace their lineage directly to the sun. The fight of a pair of pugilists, the motion of an army, or the lifting of his own body up mountain slopes by an Alpine climber, are all cases of mechanical energy drawn from the sun. Not, therefore, in a poetical, but in a purely mechanical sense, are we children of the sun. Without food we should soon oxidise our own bodies. A man weighing 150 lbs. has sixty-four lbs. of muscle; but these, when dried, reduce themselves to fifteen lbs. During an ordinary day's work, for eighty days, this mass of muscle would be wholly oxidised. Special organs which do more work would be more quickly oxidised: the heart, for example, if entirely unsustained, would be

oxidised in about a week. Take the amount of heat due to the direct oxidation of a given amount of food; a less amount of heat is developed by this food in the working animal frame, and the missing quantity is the exact equivalent of the mechanical work which the body accomplishes.

I might extend these considerations; the work, indeed, is done to my hand—but I am warned that I have kept you already too long. To whom, then, are we indebted for the striking generalisations of this evening's discourse? All that I have laid before you is the work of a man of whom you have scarcely ever heard. All that I have brought before you has been taken from the labors of a German physician, named Mayer. Without external stimulus, and pursuing his profession as town physician in Heilbronn, this man was the first to raise the conception of the interaction of natural forces to clearness in his own mind. And yet he is scarcely ever heard of in scientific lectures, and even to scientific men his merits are but partially known. Led by his own beautiful researches, and quite independent of Mayer, Mr. Joule published his first paper on the "Mechanical Value of Heat," in 1843; but in 1842 Mayer had actually calculated the mechanical equivalent of heat from data which a man of rare originality alone could turn to account. From the velocity of sound in air Mayer determined the mechanical equivalent of heat. In 1845 he published his Memoir on "Organic Motion," and applied the mechanical theory of heat in the most fearless and precise manner to vital processes. He also embraced the other natural agents in his chain of conservation. In 1853 Mr. Waterston proposed, independently, the meteoric theory of the sun's heat, and in 1854, Professor William Thomson applied his admirable mathematical powers to the development of the theory; but six years previously, the subject had been handled in a masterly manner by Mayer, and all that I have said on this subject has been derived from him. When we consider the circumstances of Mayer's life, and the period at which he wrote, we cannot fail to be struck with astonishment at what he has accomplished. Here was a man of genius working in silence, animated solely by a love of his subject, and arriving at the most important results, some time in advance of those whose lives were entirely devoted to Natural Philosophy. It was the accident of bleeding a feverish patient at Java in 1840, that led Mayer to speculate on these subjects. He noticed that the venous blood

in the tropics was of a much brighter red than in colder latitudes, and his reasoning on this fact led him into the laboratory of natural forces, where he has worked with such signal ability and success. Well, you will desire to know what has become of this man. His mind gave way; he became insane, and he was sent to a lunatic asylum. In a biographical dictionary of his country it is stated that he died there; but this is incorrect. He recovered; and, I believe, is at this moment a cultivator of vineyards in Heilbronn.

While preparing for publication my last course of lectures on Heat, I wished to make myself acquainted with all that Mayer had done in connection with this subject. I accordingly wrote to two gentlemen who above all others seemed likely to give me the information which I needed. Both of them are Germans, and both particularly distinguished in connection with the Dynamical Theory of Heat. Each of them kindly furnished me with the list of Mayer's publications, and one of them was so friendly as to order them from a bookseller, and to send them to me. This friend, in his reply to my first letter regarding Mayer, stated his belief that I should not find anything very important in Mayer's writings; but before forwarding the memoirs to me he read them himself. His letter accompanying the first of these papers, contains the following words:—"I must here retract the statement in my last letter, that you would not find much matter of importance in Mayer's writings: I am astonished at the multitude of beautiful and correct thoughts which they contain;" and he goes on to point out various important subjects, in the treatment of which Mayer had anticipated other eminent writers. My second friend, in whose own publications the name of Mayer repeatedly occurs, and whose papers containing these references were translated some years ago by myself, was, on the 10th of last month, unacquainted with the thoughtful and beautiful essay of Mayer's, entitled "Beiträge zur Dynamik des Himmels;" and in 1854, when Professor William Thomson developed in so striking a manner the meteoric theory of the sun's heat, he was certainly not aware of the existence of that essay, though from a recent number in *Macmillan's Magazine* I infer that he is now aware of it. Mayer's physiological writings have been referred to by physiologists—by Dr. Carpenter, for example—in terms of honourable recognition. We have hitherto, indeed, obtained fragmentary glimpses of the man, partly from physicists and partly

from physiologists; but his total merit has never yet been recognised as it assuredly would have been had he chosen a happier mode of publication. I do not think a greater disservice could be done to a man of science, than to overstate his claims; such overstatement is sure to recoil to the disadvantage of him in whose interest it is made. But when Mayer's opportunities, achievements, and fate are taken into account, I do not think that I shall be deeply blamed for attempting to place him in that honourable position which I believe to be his due.

Here, however, are the titles of Mayer's papers, the perusal of which will correct any error of judgment into which I may have fallen regarding their author. "Bemerkungen über die Krâfte der umbelebten Natur," Liebig's Annalen, 1842, vol. 42, p. 231; "Die Organische Bewegung in ihrem Zusammenhange mit dem Stoffwechsel;" Heilbronn, 1845; "Beitrâge zur Dynamik des Himmels," Heilbronn, 1848; "Bemerkungen über das Mechanische Equivalent der Wârme," Heilbronn, 1851.

ARTICLE XXIII.—*On the Utilisation of the Power involved in the Rise and Fall of the tides.**

The tendency of modern scientific discovery has been to show that all the various forms of force with which we are acquainted are mutually convertible into one another. Thus, of the six forces known to us in connection with the universe—gravitation, motion, light, heat, electricity, and chemical affinity—it is well known that any one of the five latter is capable, by appropriate means, of generating the other four, the force of gravitation being capable, through the medium of motion, of giving rise to the other five forces, whilst it cannot itself be generated. Gravitation may therefore be assumed to be the elemental force, since it is the only one of the six which will generate all the others. So accurately have these correlations been studied, that the quantitative value of gravitation has even been ascertained, it having been found that the mechanical force required to lift 772 pounds to the height of one foot, is capable, when converted into the force of heat, of raising the temperature of one pound of water 1° F. In other words, this amount of heat may be generated by an appropriate utilisation of the gravitating pull, exerted by a weight of 772 pounds during its downward movement through the space of one

* From the "Chemical News," 12th July, 1862.

foot. Supposing, therefore, we were in possession of an unlimited number of 772-pound weights, and were to employ in the most judicious manner the force thus evolved in their downward progress, we should have an unlimited reservoir of power which could be converted at will into light, heat, electricity, or chemical affinity, and could be made to toil for human benefit without any corresponding expenditure of human labour so long as the weights continued their downward progress unarrested. If, however, any good were to be gained by such a machine, it must be managed so that the motive force—gravitation—should always remain on the pull, and this is, and always will be, the obstacle to the attainment of perpetual motion; the act of overcoming the force of gravity to re-raise the weights, requiring the expenditure of exactly the same amount of power as has been generated during their downward fall; and so, before we can seriously discuss the feasibility of such a machine, we must find a perpetual flow of gravitating force always at hand, craving to be satisfied, and yet inexhaustible. In other words, we must construct a clock which will wind itself up when the weight has run down, without any expenditure of human power.

Sitting by the sea-shore a few days since, we could not help noticing the large reservoir of mechanical power existing in the ocean. We do not refer to the noisy dash of the waves as they break upon the beach, but to the infinitely mightier, although silent and progressive, energy exerted in the gradual rise and fall of the tides. Compared with the stupendous power capable of being utilised for man's benefit, and present in the rise or fall of millions upon millions of tons of water through a space of ten or twenty feet four times a-day, all the steam, water, or wind power in the world, together with the united muscular force of every living being, human and animal, sink into utter insignificance. We will try to form some idea of this power. Let us suppose that by the action of the tides the difference of level of the surface of the ocean at a certain spot, is 21 feet between high and low water; omitting for the present all consideration of the power of the subjacent liquid, what is the mechanical value of a space of 100 yards square of this water? 100 yards square by 21 feet deep equals 70,000 cubic yards of water, which are lifted to a height of 21 feet, or to 1,470,000 cubic yards lifted to a height of 1 foot. Now, since one cubic yard of water weighs about 1683 pounds, 1,470,000 cubic yards weighs 2,474,010,000

pounds, which is lifted in six hours. This is equivalent to lifting a weight of 412,335,000 foot-pounds in one hour; and since one horse-power is considered equivalent to raising 1,800,000 foot-pounds per hour, we have locked up in every 100 yards square of sea surface, a power equal to a 236 horse-power steam-engine, acting, be it remembered, day and night to the end of time, requiring no supervision, and costing nothing, after the first outlay, but the wear and tear of machinery.

By means of appropriate machinery connected with this tidal movement, any kind of work could be readily performed. Water could be hoisted, or air compressed to any desired extent, so as to accumulate power for future use, or for transport to distant stations. Light of surpassing splendor could be generated by means of magneto-electric machines: and with a very little exercise of ingenuity, every lighthouse on the coast could be illuminated with sun-like brilliancy, and with absolutely no expenditure of fuel; the very same mechanical power of the ocean, which in its brute force would dash the helpless vessel to pieces against the rocks, being bound and coerced like the genii in Eastern tales, and transformed by man's intellect into a luminous beacon to warn the mariner against the approach of danger.

ARTICLE XXIV.—*On the various theoretical views regarding the origin of the Primitive Formations.* Translated from the German of Carl Freidrich Naumann, (*Lehrbuch der Geognosie* II. 160), by THOMAS MACFARLANE.

The parallel structure, and the stratification of gneiss, mica-schist, etc., have, from the earliest dates of geological history, given rise to the opinion that water must, in some way or other, have had a part in the formation of these rocks. Werner and other geologists believed it to be even possible that they had been deposited from the waters of the ancient ocean, as crystalline sediments. But seeing that the mineralogical composition of the gneiss does not appear to be compatible with this view, geologists sought to explain the sedimentary origin of these rocks in a somewhat different manner. Thus, Von Beroldingen declared gneiss to be but a regenerated granite, that is to say, a rock resulting from granitic sand, washed together, in which the mica laminæ came to be deposited parallel with each other, among the grains of feldspar and quartz. The same view was later enunciated by Boué (Essai géologique sur l'Ecosse, p. 445), but afterwards

again abandoned by him. Saussure, also, expressed himself in most decided opposition to Von Beroldingen's views. While narrating that Monte Rosa, from base to summit, consists of gneiss and rocks related to it, he says: "On ne dira donc plus, que les granites veinés, le gneiss et les autres roches de ce genre, ne sont que les débris des granits, rassemblés et agglutinés au pied des hautes montagnes."* Moreover, (in a note to § 2143 of the work just quoted), Saussure, otherwise mild and delicate in judging and confuting the opinions of others, deals very severely with Von Beroldingen's gneiss theory.†

Somewhat related to this old view is the supposition expressed more recently by Dana, that gneiss and mica-schist bear a relation to granite, similar to that in which basaltic tufa stands to basalt, or volcanic tufa to lava; the materials of these rocks (the gneiss and mica-schist) having been thrown up to the surface before and during the eruptions of the granite, in the form of sand-like ejections, and transformed into gneiss and mica-schist by the action of glowing hot water. The perfect and thoroughly crystalline character of the gneiss, the enormous extent which the primitive formations occupy in so many districts, the architecture of these great gneiss districts, and their occurrence totally independent of larger granitic masses, are all incompatible with this idea.

In certain respects the Huttonian theory, which afterwards became so influential, may be compared with that of Von Beroldingen's, since this celebrated Scottish geologist, in his Theory of the Earth in 1795, attempted, with much minuteness, to prove that the whole of the so-called primitive rocks had been formed of the débris of older preexisting rocks, deposited on the bed of the ocean; the strata, consisting originally of loose materials, having been, under the pressure of the ocean, exposed to a high temperature for a long time, in which manner their consolidation was effected.‡

* Voyage dans les Alpes, § 2139.

† Especially on account of Beroldingen asserting that the opponents of his theory were destitute of all geological knowledge, and saying that the circulation of their writings ought to be prohibited. Beroldingen's writings, Saussure thought it was altogether unnecessary to prohibit; "l'extrême désordre, l'intolérable diffusion, et les perpétuelles contradictions qui y règnent en dégouteraient assez le plus grand nombre des lecteurs."

‡ Compare Explication de Playfair sur la théorie de la terre, par Hutton, traduit par Basset. Paris, 1815.

At present there are especially two hypotheses maintained by different parties, regarding the origin of gneiss, and of the rocks associated with it. The first of these theories is founded on the notion of the metamorphism of rocks, and the second, on the theory of the originally fused condition of our planet.

The great majority of the geologists of the present day incline to the opinion that these oldest cryptogenous rocks, as wel as the recent formations resembling them, have been produced by a peculiar metamorphosis of preexisting sedimentary strata; consisting essentially in a recrystallisation of the materials of these strata, and caused either by a high temperature, or by molecular movements excited in some other way.

The supporters of this theory found it especially upon the parallel structure and stratification of these rocks, upon the indisputable fact that clay-slate in the neighborhood of large granite masses is frequently changed into mica-schist and rocks of a gneissoid character, and upon the scarcely doubtful fact that in many countries, gradual transitions may be followed, from gneiss, through mica-schist and clay-slate, into greywacke slate. By these transitions, gneiss is brought into such close connection with greywacke slate, that these appear only as the extreme members of a single series; for the whole of which one and the same original mode of formation must be assumed. Now since greywacke slate is undoubtedly a sedimentary rock, the clay-slate, mica-schist and gneiss lying under it, must have been something similar. But because the mineralogical composition and the crystalline nature of these deeper rocks appear the more opposed to this inference the deeper they lie, the disciples of the metamorphic theory were obliged to suppose the action of a metamorphism working from beneath, which has reacted upon, and so altered these oldest sedimentary strata, that they now appear as gneiss and mica-schist.

This theory, which at the first glance appears so satisfactory, was first enunciated by Boué in 1822, was afterwards adopted by many other geologists, and found in the year 1833 more decided expression through Lyell, who gave the strata thus altered the name of hypogenous metamorphic rocks; a title which is intended to indicate a metamorphosis which took place in the depths of the earth's crust, and proceeded from beneath upwards. Properly speaking, these views were very similar to those which Hutton attempted to establish in the years 1788 and 1795,* and his

* His Theory of the Earth appeared for the first time in the Edinburgh Philosophical Transactions for 1788.

commentator Playfair, in 1802; so that it is in reality possible to maintain that the present theory of the metamorphic origin of the primitive formations is only a farther development of the Huttonian theory. Boué however first understood how to bring this theory into more decided harmony with the details of geological phenomena, and besides making use of internal heat, brought emanations of gases and vapors out of the interior of the earth, to his assistance, in order to explain the alteration of sedimentary slates into gneiss and mica-schist. "La chaleur ignée," says he, "et les émanations gazeuses de l'intérieur de la terre auraient donné aux schistes, peu à peu, et sous une plus ou moins forte compression, une espèce de liquéfaction ignée, assez semblable à celle dont M. de Drée a fait mention dans ses belles expériences.* Les élemens des schistes auraient perdu de leur force de cohésion, leurs parties constituantes auraient été écartées les unes des autres, at les émanations gazeuses auraient pu s'insinuer dans les vides ainsi laissés. De cette manière les affinités chimiques auraient pu s'exercer dans certaines limites, posées par les forces adverses de la cohésion, et les parties constituantes des roches auraient pu prendre, pendant la liquéfaction et le refroidissement lent, un arrangement plus ou moins crystallin, suivant les circonstances, et sans déranger ou detruire notablement la structure feuilletée primitive. De plus, le jeu des affinités chimiques, aidée par les substances étrangères, introduites, pour ainsi dire, par sublimation, dans ces roches, aurait donné naissance à cette foule d'espèces minérales crystallines, qui sont disséminées dans nids, en amas, et en petits filons au milieu des schistes crystallins. Cette théorie hardie présente du moins incontestablement l'avantage d'expliquer tous les faits géologique d'une manière satisfaisante."†

Very many geologists agree with this theory in its principal features. Others, among whom may be especially mentioned Keilhau, Studer and Escher, think it doubtful that the metamorphosis has been accomplished by high temperature, and by vapors, and believe rather, that inward transforming processes may have come into operation at ordinary temperatures, whose

* De Drée described these experiments in the Journal des Mines, No. 139. The principal point to which Boué refers is that the melted or half-melted rocks preserved their texture, and the distribution of their constituent particles unchanged, as has also later been shown by Gerhard to be the case with granulite.

† Annales des Sciences Naturelles, 1824, Août, p. 417.

inferior energy may have been compensated for by their long duration. But while these philosophers do not express a decided opinion regarding the real character of these transforming processes, G. Bischof and Haidinger are inclined to suppose that a long continued percolation of water through the rocks* has produced a substantial alteration and recrystallization, in the same way as must have taken place in the production of certain alteration pseudomorphs.† Many believe it possible to indicate more nearly the sedimentary rocks from which these cryptogenous rocks have been produced. Thus, in 1833, Hitchcock was of opinion that the gneiss had probably been previously a coarse micaceous sandstone, a view which Durocher also adopted, while Forchhammer believed it possible to prove that the gneiss of Egeberg, near Christiana, was produced from the alum-schist, which occurs there.‡

We have already remarked however that parallel structure and stratification, cannot in every case, be considered as decisive proofs of sedimentary origin. Even Macculloch, in other respects a zealous supporter of the metamorphic theory, admits this. He says expressly that he is obliged to explain the parallelism of the laminæ of mica, so often adduced, as a proof of the sedimentary deposition of gneiss, in quite another manner, because even hypersthenite sometimes shows a parallel deposition of its crystals of hypersthene, and at Kerrera a trap which occurs in veins is, like mica slate, filled with scales of mica, all lying parallel with the sides of the vein.

We have also already mentioned the doubts brought forward by Hoffman and Riviere against the view that widely extended gneiss areas are to be considered as altered sedimentary masses. De

* So early as the year 1785, Von Trebra enunciated the view that the alteration of whole mountain masses, for example, of granite into gneiss, and of greywacke into clay slate, had been caused by a very long continued process of alteration, which he characterised as a sort of fermentation, and which was produced essentially by the circulation of water, and by the action of heat. Since these causes, which although unperceived, are nevertheless thoroughly active, and still at work, and will continue, so as long as circulation goes on in the immeasurable round of nature, he is convinced that the alterations, decompositions and recompositions which they produce everywhere in the interior of the rocks will continue as long as the world itself.—(*Erfahrungen von Innern der Gebirge*, p. 48.)

† Lehrbuch der Phys. und Chem. Geologie, II. 247.

‡ Journal für Praktische Chemie. Bd. 36, 1845, S. 404.

la Beche expressed himself, even earlier, in the same manner as Riviere, and doubted whether the metamorphic theory (the sweeping hypothesis, as he called it) was admissible in such cases, although he quite acknowledges it within its proper limits (Report on the Geology of Cornwall, p. 34). With this, A. Erdmann, a high authority with regard to the Swedish primitive rocks, and Von Blöde, who has explored Finland in various directions, perfectly agree. Von Blöde says: that the metamorphism is undeniably present where it can be recognised by observation, and explained generally by physical science. Still the class of rocks with which this is the case, is only limited, and not at all favorable to the baseless hypothesis which is now being carried to extremes. (Neues Jahrbuch für Mineralogie, 1844, s. 53.) Von Leonhard, Petzholdt and others, have also repeatedly declared against the too wide extension of the metamorphic theory, and we are obliged, from complete conviction, to rank ourselves with them. The transitions from gneiss, through mica-schist, into crystalline clay-slate are not to be denied, but whether the transitions from crystalline clay-slate into real greywacke slate may pass, in every case, for fully proved, may still be doubted. Grüner remarks distinctly that the clay-slate which is associated with gneiss and mica-schist is always different from the clay-slate of the greywacke; for which reason he declares himself unable to assert that these older rocks, as they appear in the departments of the Rhone and Loire, are metamorphosed greywacke slates. (Ann. des Mines, 3ième série, t. 19, 1841, p. 70).

In our opinion the principal difficulty, and one scarcely to be overcome, lies in the fact that there are far younger gneisses mica-schists, etc., which overlie sedimentary rocks, without the slightest transition into these underlying rocks being observable. In such cases every idea must disappear relative to a hypogenous or anogenous metamorphosis; for how could the overlying rock have been metamorphosed by some agency from beneath, while the strata beneath remain unaffected by any influence. Just as little can a catogenous metamorphosis be thought of, for whatever cause one may suppose as the real agency, it is impossible that it can have found in descending, such a sudden and entire check, along one and the same plane of deposition, that the completely re-crystallised rock, should be, by this plane of deposition, separated from the perfectly unchanged rock. In such cases there is nothing left for us but the supposition that these strati-

fied, crystalline, silicated rocks, have been originally formed, and deposited, in the state in which they now appear to us. If we are not able to comprehend the modality of their process of formation, we can comfort ourselves with the adherents of ultra-metamorphism, who are quite as much at a loss. After all, it is perhaps immaterial whether we assume a problematical process of alteration, or a problematical process of formation; but if we were, once for all, to choose between one of the two enigmas, we would probably rather prefer the latter, which at least is in unison with the state of the facts. A second objection against the too wide application of the metamorphic theory, arises out of the fact that many gneissoid rocks shew undoubted evidences of an eruptive origin, and that granulite also, which is so nearly related to gneiss, sometimes occurs under such circumstances as appear to demand for it an eruptive mode of formation. If this is really the case, it is a proof that certain cryptogenous rocks are decidedly not of metamorphic origin.

The great resemblance which gneiss and the most of the rocks accompanying it, bear to granite and other eruptive rocks; the probability that the most of these eruptive rocks have been solidified from a state of igneous fluidity; the almost unavoidable assumption that our planet was originally in the same state, and was only later covered with a solidified crust; finally the fact that in the primitive gneiss formation, granite and gneiss are found regularly interstratified with each other, have called forth the second of the hypotheses prevailing at present; namely, that the primitive formations form the first solidified crust of our planet.

This hypothesis has not indeed found so many supporters* as that of the metamorphic origin of the primitive rocks, nevertheless the objections against it are probably neither greater nor more numerous than against the latter. It leads necessarily to

* The following geologists support this theory: Fleurian de Bellevue, (Journal de Physique, an XIII); Breislak, (Lehrbuch der Geol., I, 372); Cordier, in the third part of his celebrated treatise on the temperature of the interior of the earth, (Ann. des Mines 2, série II, p. 120); Marcel de Serres; Kapp, (Neues Jahrbuch für Min. 1834, 255, and 1843, 326); Von Blöde, Neues Jahrbuch für Min. 1837, 176; De la Beche, Report on the Geology of Cornwall, &c., 1839, p. 31; Petzholdt, Geologie, 1840, p. 24, and 1845, p. 35; de Roys, Bull. de la Soc. Géol. XIII, 1840, p. 240; Scheerer, Karsten and Von Dechen, Archiv. vol. 16, 1842, p. 159; Nöggerath, Entstehung der Erde, 1843; Cotta, Grundriss der Geognosie, 1846, p. 161; Rivière, Bull. de la Soc. Géol., 2 série VII, p. 327.

the inference that the succession of the primitive rocks in a downward direction, corresponds to their age from oldest to youngest, because it was, of course, through a solidification from the outside inwardly, that the strata in question were formed, (Lehrbuch I, 489). The only way of explaining the origin of the newer cryptogenous rocks, left to the supporters of this hypothesis, is to suppose that their material has been protruded from the interior through the earth's crust in an eruptive form.

The most considerable difficulties which this hypothesis has to contend with, arise from the relations of the structure of the primitive formations, and from the mineralogical character of certain of the rocks belonging to it. Whether these difficulties can be explained away by the supposition of a hydro-pyrogenous development of the outside part of the primitive solidified crust, as indicated by Angelot, Rozet, Fournet, Scheerer and others, we must leave undecided in the meantime. Scheerer attempted, in a peculiar manner, to overcome the difficulties which the structure and architecture of the gneiss present. He regards them as an original phenomenon, produced during the solidification itself, by the action of electro-magnetic currents; and comes to the final conclusion, "that the primitive formations, with all the diversity of their rocks, are only to be regarded as the first hardened crust of the solidifying earth." If the vertical position of the primitive gneiss strata, as displayed in their parallel-zoned, fan-shaped and gable-formed architecture, is really to be looked upon as their original position, then the verdict which Kittel thus expressed, must be pronounced correct: "so long as a hypothesis is unable thoroughly to explain the almost vertical position of the primitive strata, it cannot be regarded as even approximately near the truth." (Skizze der geogn. Verhältnisse von Aschaffenburg, p. 40).

Scheerer concludes from the contortions and undulations of the gneiss layers, that the primitive rocks must have originally been in a soft, plastic state, and Macculloch, even earlier, arrived at the same conclusion, from the surprising contortions of the mica-schist, which he compared with similar windings in the structure of certain basalts. There is probably nothing to be said against the correctness of this deduction, which receives complete confirmation from the so frequently occurring elongation of the constituent of gneiss and other primitive rocks. But whether this plastic condition has been occasioned by high temperature alone,

or by the simultaneous action of heat and water, or only by the latter element, are questions whose solution we must still expect from the future. In the meantime the real mode in which the primitive rocks have been formed, is still involved in such obscurity, that they may, with complete justice, be termed cryptogenous rocks.

Note to the preceding paper; by T. Sterry Hunt, M.A., F.R.S.

The foregoing sketch of the progress of theoretical views as to the origin of the crystalline rocks, gives an excellent statement of the question up to 1857; since which time more definite notions as to the nature of the metamorphic process, as understood by Hutton and Boué, have begun to be entertained. The problem of rock metamorphism is the conversion of mechanical or chemical sediments into definite mineral species, by molecular changes; that is to say, by crystallization, and a re-arrangement of their particles; or by chemical reactions between the elements of the sediments. Pseudomorphism, which is the change of one mineral species into another, by the introduction, or the elimination of some element, presupposes metamorphism; since only the definite mineral species of metamorphic or plutonic rocks can be the subjects of this process. To confound metamorphism with pseudomorphism, as Bischoff, and others after him have done, is therefore an error. It may be further remarked, that, although certain pseudomorphic changes may take place in some mineral species, in veins, and near to the surface; the alteration of great masses of silicated rocks by such a process, is as yet an unproved hypothesis.

The study of the local metamorphism of sediments in the vicinity of intrusive rocks, goes far to show, in opposition to the opinions of some authors quoted above, that heat has been one of the necessary conditions of metamorphism. In 1857, I showed by experiments, that besides heat and moisture, certain chemical reagents might be requisite, and that water impregnated with alkaline carbonates or silicates, would at a temperature not above that of boiling water, produce chemical reactions among the elements of many sedimentary rocks; dissolving silica and generating various silicates. Some months subsequently, Daubrée found that in the presence of solution of alkaline silicates, at temperatures above 700° F., various silicious minerals, such as quartz, feldspar and pyroxene, could be made to assume a crystalline form; and that alkaline silicates, under these conditions,

might combine with argillaceous matters to produce feldspar and mica. These observations were the complement of my own, and both together showed the agency of heated alkaline waters to be sufficient to effect the metamorphism of sediments, by the two modes just mentioned; namely, by molecular changes, and by chemical reactions.

Following upon this, Daubrée observed that the thermal spring at Plombières, at a temperature of 160° F., had, in the course of centuries, given rise to the formation of zeolites, and of various other crystalline silicated minerals, among the bricks and cement of the old Roman baths. From this, he was led to suppose that the metamorphism of great regions might have been effected by hot springs; which rising along certain lines of dislocation, and thence spreading laterally, might produce alteration in strata near to the surface; while those beneath would, in some cases, escape alteration. In this way, would be resolved the great difficulty urged by Naumann against the theory of metamorphism by heat from below; namely, that in descending, a certain plane, sometimes limits the metamorphism, and separates the altered strata above from the unaltered ones beneath, without any apparent transition between the two.

Daubrée's ingenious hypotheses of metamorphism by hot springs, in some instances meets this difficulty; but while undoubtedly true in certain cases of local alteration, it seems utterly inadequate to explain the complete and universal metamorphism of areas of sedimentary rocks, embracing many hundred thousands of square miles. On the other hand, the study of the origin and distribution of mineral springs, shows that the alkaline waters, whose action in metamorphism I first pointed out, and whose efficient agency Daubrée has so beautifully shown, are confined to certain sedimentary deposits, and to certain stratigraphical horizons; above and below which, waters totally unlike in character, are found impregnating the strata. This fact seems to offer a simple solution of the difficulty advanced by Naumann, and a complete explanation of the theory of metamorphism of deeply buried strata, by the agency of ascending heat; which is operative in producing chemical changes only in those strata in which soluble alkaline salts are present. See farther on this subject, the *Canadian Naturalist*, vol. iv. page 414; the *Quarterly Journal of the Geological Society of London*, for 1859, page 488; and the Report of the Geological Survey of Canada for 1853-56, page 477.

ARTICLE XXV.—*On Aphis Avenæ.* By GEORGE LAWSON, Ph., D., LL.D.

(*For the Canadian Naturalist*).

In my Report on the Insects affecting the Field Crops, &c., in Canada, during the season of 1861, notice was taken of the sudden appearance of the Wheat or Grain Aphis (not found to be identical with the *Aphis Avenæ* of Europe,) in alarming numbers on Wheat, Oats, Rye, &c. During the present season (1862) the insect has played over again the part which it took in 1861, and which created so much alarm among our farmers. They are better acquainted with the stranger now, knowing that he comes merely to suck the green juicy grain without the means of doing much mischief; but, having obviously become a permanent colonist, it is desirable that a few facts connected with his first appearance and settlement in our country should be placed on record in the *Canadian Naturalist.*

In the beginning of August, 1861, ears of wheat infested with this insect were transmitted to me by several farmers and others in the neighbourhood of Kingston, all of whom regarded the insect as a new pest to the country. The earliest examples were received from Professor Williamson, Portsmouth, John Duff, Esq., Princess Street, A. Drummond, Esq., Manager of the Montreal Bank, Messrs. Platt, Napanee, and from farmers in the neighbourhood of Odessa, and in Pittsburg. A few days afterwards reports were found in the newspapers of its appearance in various parts of Upper and Lower Canada, and over a considerable portion of the Northern States; all reports spoke of the insect as new and unknown to the farmers. More special enquiry among entomological friends and reference to published works, only served to confirm the surmise that there existed no record or tradition of its previous occurrence in our fields. Prof. Williamson, who had for many years observed with care the insects affecting the crops in this locality, had not previously seen this species of Aphis on any of the grains; numerous farmers of whom enquiries were made in different parts of the country knew nothing of the insect in former years. And, lastly, Dr. Asa Fitch, the able entomologist to the State of New York, whose keen eye has added so much to our knowledge of economic entomology, recognised in the Aphis a new vagabond whose photograph and antecedents required to be reported to the State authorities.

The insect is individually minute, like all the Aphides, but pre-

sents a formidable appearance on account of the vastness of its numbers. In some fields, a few days after its first appearance, the ears of grain became covered with it; in fact the wheat was commonly spoken of as "dark with it." The fly presented itself chiefly in the wingless form, the individuals clustering in great numbers in the upper parts of the culms and panicles of wheat, rye, oats and barley, and this season they have been observed on indian corn and various other grasses. Most of them are stationary, but some are usually moving about with a rather awkward motion resembling that of mites under a magnifying glass. On each panicle or head of grain they are found to be of various sizes, according to age, some scarcely large enough to be visible to the naked eye, others as large as the capital letters on this printed page. They vary in colour; some are pale apple-green, some of a brownish yellow colour, and many, especially the older and larger ones, are of a rather deep brick-red colour, when they become very conspicuous. In some cases where the whole ears were covered with the insects, the total destruction of the crops seemed to some of the farmers to be inevitable. They looked upon the "new bug plague" (for everything that looks like an insect is called a bug) as the greatest calamity that had ever befallen our fields. It was deemed advisable therefore to publish in the Kingston newspapers an account of the habits of the insect, with the view of allaying unnecessary fears. Attention was drawn to the following among other facts:—The aphides do not gnaw the plant's stem and leaves like caterpillars, nor like the wheat midge, injuriously affect the young grain, but simply suck the juices of the exposed parts of the plant. The plant necessarily suffers from this injury, its energies are weakened, the leaves and other parts shrivel and blister, and an inroad is formed for other diseases; but, while aphides are highly injurious to thin and succulent leaved plants, the compact tissue of wheat and other grains, hardened too by silica, is not so liable to suffer and become deformed, and a vigorous healthy crop of grain will hardly be injured. No doubt the yield is lessened by the presence of the insect in vast numbers, and the quality of the grain perhaps slightly deteriorated, but the injurious effects are by no means so extensive as the formidable appearance of the insects would indicate.

In Britain the bean crop is annually liable to the attacks of an allied black species (*Aphis Rumicis*) which appears in such num-

bers that in autumn when many of the individuals have acquired wings and left the bean fields, they spread over the country, darkening the atmosphere with living clouds,—yet the farmers do not find their bean crops very light, even during the worst seasons of this so called "cholera fly." Items of information and assurances such as the above served to allay the fears of the farmers, and to prevent unnecessary expenditure of time and money and probable injury to the crops in experimenting with the various remedial applications recommended in the public prints to stay the "insect plague," such as smearing the standing grain with gum arabic, pulverised hellebore, scotch snuff, flowers of sulphur, aloes and other substances, which, however obnoxious, they might have been to the aphis, would not have improved, by any means, the flavour of the grain and flour.

As the season advanced, the aphides increased in numbers, and were no longer confined to wheat, but became abundant and conspicuous on oats and rye. Daily parcels of grain ears were being received from various ports of the country from farmers who feared that, while entomologists were ferreting out the history of the insect, their crops would in the meantime be eaten up. In the counties of Frontenac, Lennox and Addington, the insect was universal. Wheat proved to be generally light; but the real damage seems to have been done by a less conspicuous but more destructive insect,—the wheat midge,—which was at work early in the season, and, being a sly rogue in grain, was probably not observed by many of the farmers, although quite common in the Kingston district.

As the season advanced, the insects preying upon the aphis seemed to increase; but the most marked effect was observed to result from the heavy rains of the night of Wednesday, 21st, and Thursday, 22d August, which very sensibly reduced the numbers of the aphis. Gardeners say that watering plants overhead rather encourages the production of aphides than otherwise. No doubt aphides like moisture, and especially a moist atmosphere. But it was long ago observed by my correspondent, Mr. Hardy, of Penmanshiel, who has devoted special attention to these insects, that heavy rains served to dispel them.

During the present season (1862) the aphis has again made its appearance, and in as great numbers as before. It has naturally attracted less notice, but appears to be widely diffused in all the cultivated parts of central Canada. In August, 1862, I traced it

from Kingston, on the scattered farms along the Addington Road, back to the township of Olden, a distance of about fifty miles. When we consider that many of the farms referred to are mere isolated patches of clearing in the woods, widely separated from each other, in some cases by miles of interminable forest and swamp, we see that the diffusion of this insect is totally independent of its own limited locomotive powers. In its winged state it is no doubt carried in clouds by the winds, like the seeds of thistles and other winged plants.

In looking over a general collection of insects, one is struck with the large numbers of species peculiar to certain countries or districts, and which, in spite of their locomotive powers and other means of diffusion, seem to persist in adherence to circumscribed localities. The aphides are of a different character; those of them which infest cultivated plants may probably, with most truth, be regarded as cosmopolitan, having no special regulating influences that we know of beyond the supply of their food and *extremes* of climate. They are like the corn weeds that spring up wherever the cereal grains are cultivated, and whose original nativity has been lost. The careful observation of animals and plants of this character, in a new country where settlement is still progressing, is calculated to afford valuable information to the zoological and botanical geographer.

The wingless aphides found in such numbers during the summer are all females, but some of the females are winged. Remarkable as it may appear, it is nevertheless true, that the females have the power of bringing forth living young, without any intercourse of the sexes. This may be readily observed by enclosing one under a glass, and observing the production of new individuals, which is regarded by naturalists rather as the result of a process of budding than a true reproductive process. Late in the season, when cold weather comes on, males are produced, all being winged; they are known from the winged females by the absence of the tail-like process at the apex of the abdomen. The sexes pair, the females lay eggs, these may remain dormant and be hatched during the following spring, and the young issuing from them are females, capable of giving birth, as before mentioned, to successive broods of young, in a viviparous manner, in the absence of males.

The reproduction of aphides thus presents some of the most remarkable phenomena with which naturalists are acquainted,

but which are now explained by corresponding peculiarities in some other groups. A full history of the enquiries of Bonnet and others was given by Mr. Hardy, in a series of papers published some years ago in the *Scottish Gardener.*

Prof. Huxley's important papers "On the Agamic Reproduction and Morphology of Aphis" will be found in the third part of the 22d volume of the Transactions of the Linnean Society (1858).

The following is a detailed description of the wheat or grain aphis:

Aphis Avenæ.—Plump, pale reddish to brown or apple-green (usually pale-red but very various as regards colour), with blackish legs and feelers, appears late in summer in colonies, on flowering panicles of grasses and cereal grains, becoming winged and leaving the ears, as the season advances and the grain ripens.

Viviparous Wingless Female.—Body, medium sized, $\frac{1}{16}$th to $\frac{1}{10}$th of an inch in length, oval-oblong, convex with a rim on each side, more or less glossy, especially when mature, varying in colour from pale apple-yellow to deep reddish yellow or reddish brown when young, becoming darker when old; often of a deep brick-red or chestnut brown, especially on the dorsal surface of the abdomen and other exposed parts, rarely the whole body is of a dull glaucous green, sparsely covered with scattered hairs. The feelers are black, rather more than half the length of the body, rough throughout with bristly hairs, the two basal joints short and thick, especially the first, the terminal one remarkably long and slender, transversely notched throughout its whole length, the intermediate ones four or five times as long as broad (only six joints are developed). The eyes are dark, the rostrum quarter the length of the body, of a yellowish or tawny hue, the terminal joint black, the nectaries almost black. The legs are tawny, the knees, the feet, and the tips of the shanks black, all rather closely covered with bristly hair.

Viviparous Winged Female.—Dark brown, sometimes almost black, feelers longer than the body, hairy, dorsal processes of the abdomen ("nectaries") about a fifth the length of the body; legs dark, the knees, feet, &c., black, hairy; wings ample, colourless, longer than the body. Size of body $\frac{1}{8}$ inch; of the wings $\frac{1}{7}$ inch. Mr. Walker has been very successful in distinguishing aphides by the venation of the wings. I therefore give in his words the description of the wing veins:—" Distance between the first and second veins at the base less than half that between them at the

tips; third farther from the second at the tip than it is at the base, as near to the second at the base as the second is to the first; first fork nearer to the second fork than to the third vein, nearer to the third vein than the third vein is to the second; second fork a little nearer to the fourth vein than to the first fork; fourth vein much curved near the base, almost straight towards the tip, very much nearer to the second fork than to the tip of the rib-vein."

The synonymy of this species is as follows:—

Aphis Avenæ, Fabricius. Schrank; Gmelin Ed., Syst. Nat. Linn. 1, pt. 4, p. 2206. Villers, Stewart, Turton Ed., Syst. Nat. Linn. 11, pt. 1, p. 705. Macquart, Walker, "Ann. Nat. Hist. ser. 2, III, pp. 45, 57," and in List of Homop. Insects in Brit. Mus. IV, p. 972.

Aphis granaria, Kirby, "Linn. Trans. IV, p. 238,"

Curtis. Fitch, Count. Gent., Albany, N. Y., Aug. 16, 1861, XVIII, p. 114.

Aphis Hordei, Kyber.

Aphis cerealis, Kaltenbach.

Bromaphis, Amyst, "Ann. Soc. Ent. Fr., 2e Série, V, p. 479.

In order to ascertain with precision whether our Canadian insect was identical with the European one, I sent specimens to Mr. Walker of the British Museum, who is well known to be the ablest authority in this difficult and confused branch of Entomology, and he, in the kindest manner examined the specimens and expressed himself as *sure of its identity with the European species.* Dr. Asa Fitch, of Salem, Mass., who has studied the habits of the new aphis with great care, writes to me that he is satisfied of its identity with the *A. avenæ* of Europe. Mr. Walker in his letter to me dated South Grove, Highgate, near London, Sept. 19, 1861, observes:—"The colour of this and of many other kinds of Aphis is very variable, and is therefore of no use in identifying the species. It occurs of different shades of green-red and of brown, and is occasionally mottled with these colours. I do not think that there is need to be much alarmed at its appearance, or that it will inflict serious or permanent injury, for its swarms are only occasional, and not annual. When it is once established on the corn, the attempt to arrest its ravages is useless, neither do I believe that it can be hindered from migrating to the corn, for its natural or original food is various kinds of grass, and when its wings are

developed, and its supply of food fails, it seeks for other means of subsistence. I do not see any mention of it in Fitch's "Noxious Insects," but I believe that his *Aphis Maidis* is the same species. It has been observed on the following plants:—Secale cereale, Friticum æstivum, &c., Avena sativa, Danthonia strigosa, Hordeum vulgare, H. murinum, Bromus mollis, B. secalinus, Dactylis glomerata, Holcus lanatus, Glyceria fluitans, Poa annua, &c., Polygonum Persicaria."

Mr. Walker calls attention to the fact that the aphis has many insect and other enemies in Europe, and it Canada it also has its enemies which have during the past two seasons been busily at work lessening its numbers. These have been so graphicallly depicted by Dr. Fitch, in the Albany Country Gentleman, that I cite his description:—"On many of the wheat heads may at present be noticed from one to half a dozen or more of these lice, which are very large, plump and swollen, of the colour of brown paper, standing in a posture so perfectly natural you suppose they are alive. Touch them with a point of a pin, you find they are dead. Pick off a part of their brittle skin; you see there is inside a white maggot, doubled together like a ball. Put one or two of these wheat heads in a vial, closing its mouth with a wad of cotton. In a week's time or less, you find running actively about in the vial, some little black flies like small ants. These you see have come out from the dead lice through a circular opening which has been cut in their backs. Drive one or two of these flies into another vial, and introduce to them a wheat having some fresh lice. See how the fly runs about among them examining them with its antennæ. Having found one adapted to its wants, watch how dexterously it curves its body forward under its breast, bringing the tip before its face, as if to take aim with its sting. There, the aphis gives a shrug, the fly has pricked it with its sting, an egg has been lodged under its skin, from which will grow a maggot like that first seen inside of the dead swollen aphis. And thus the little fly runs busily around among the lice on the wheat heads, stinging one after another, till it exhausts its stock of eggs, a hundred probably or more, thus insuring the death of that number of lice. And of its progeny, fifty we may suppose to be females, by which five thousand more will be destroyed. We thus see what effectual agents these parasites are in subduing the insects on which they prey. I find three different species of them now at work in our fields destroying this grain aphis. I have not space here to describe

them. A particular account of them will be given in my Report in the forthcoming volume of Transactions of our State Agricultural Society. And aiding these parasites in the work which they have been created to perform, are several other insects, to which I can only briefly allude. A lady bug or Coccinella (*C 9-notata*, Herbst) a pretty little beetle, nearly the size and shape of a half pea, of a bright yellow or red color, with nine small black spots, has all season been common in our grain field, it and its larvæ feeding on this aphis. Another insect of the same kind, but much smaller and black, with ten yellow dots on its wing covers, (*Brachyacantha 10-pustulata*, Melsheimer,) is little less common. The Chrosopa, or Goldeneye flies, are also there, placing their white eggs at the summit of slender threads, that their young may feed on these lice. The larvæ of different Syrphus flies, small worms shaped like leeches, may also be seen on the grain heads, reaching about as an elephant does with his trunk, till an aphis is found, which is thereupon immediately seized and pulled from its foothold and devoured."

In Britain, the aphides are fed upon by earwigs.

We have in Canada a large number of aphides, two of which were very destructive last year. One of them, *Aphis Brassicæ*, attacks cauliflowers, Brussels sprouts, cabbages, &c., and another *Aphis Cerasi*, is very injurious to the cherry tree, especially in orchard houses and sheltered situations. These two species have been fully described in the Proceedings of the Botanical Society of Canada.

ARTICLE XXVI.—*On the footprints of Limulus as compared with the Protichnites of the Potsdam sandstone.* By J. W. Dawson, LL.D., F.R.S., &c.

Prof. Owen in his description of the remarkable footprints from the Potsdam sandstone of Beauharnois, submitted to him by Sir W. E. Logan,* after referring these probably to crustaceans, remarks, "The *Limulus*, which has the small anterior pair of limbs near the middle line, and the next four lateral pairs of limbs bifurcate at the free extremity, the last pair of lateral limbs with four lamelliform appendages, and a long and slender hard tail, comes the nearest to my idea of the kind of animal which has left the impressions on the Potsdam sandstone." I do not know that this view of Prof. Owen has ever been subjected to the test of experiment, and having on a late visit to Orchard Beach ob-

* Journal of Geological Society of London. Vol. 8.

tained a living Limulus,* it occurred to me to observe the nature of its footmarks, and to compare these with the ancient *Protichnites.* The Limulus frequents this beach, which in its appearance and character is probably not unlike the sandy flats represented by the Potsdam sandstone, in the spring, for the purpose of spawning, and in storms many of them are cast on shore. In summer they are more rare, and my specimen was a small individual taken in a pool of salt water near the mouth of the Scarborough river. I had no means of preserving permanent impressions of its footprints, but tried its mode of locomotion under various conditions on the sandy shore, and preserved sketches of the markings.

The Limulus is provided with three sorts of locomotive apparatus. In the male three pairs, and in the female four pairs of the thoracic feet are didactyle, walking and prehensile feet, serving for locomotion on hard bottom under water. The posterior pair of thoracic feet are longer and stronger than the others, and furnished, in addition to a small didactyle foot, with four broad, flat claws or nails, which when spread out and pressed against the surface, enable the creature to move on the moist sand of the shore, and also to scoop out the sand and force itself beneath the surface in burrowing. Lastly, the flat abdominal feet are used for swimming, and with the aid of these the creature could rise to the surface and swim around a pail in which it was kept. Its motions were not rapid, and its principal means of security seemed to be burrowing under the sand, and when touched doubling up the abdomen under the thorax in the manner of a Trilobite, though less perfectly, and at the same time erecting and brandishing the sharp caudal spine.

When laid on damp sand near the margin of the sea, the creature immediately began to walk, but in a circuitous manner without apparent object. Its body rested upon the edges of the broad cephalo-thorax, as on a pair of sleigh runners, and it urged itself forward principally by the two posterior feet. The impressions made consisted of two distinct furrows, with slight ridges exterior to these, formed by the edges of the carapace. Within these were series of punctures, deepest behind, in which the four marks left by the nails of the posterior feet were most prominent, and sometimes the only marks seen. In the centre was an irregular groove formed by the tail spine, which was drawn along

* *Limulus polyphemus*, Latreille; *Polyphemus occidentalis*, Lamarck.

the sand, but occasionally moved slightly from side to side, or up and down, in such a manner as to make a broken, irregular trail. When the creature turned abruptly, the impressions on the inner side of the curve were much stronger than those on the outer, and the tail mark became more irregular, or was drawn toward the inner side. Occasionally the spines on the sides of the abdomen touched the ground, and produced slight longitudinal scratches among the footprints. These appearances are represented in Fig. 1, reduced to one-third of the natural size.

Fig. 1.

As compared with *Protichnites* these tracks of the Limulus agree in the median groove, and in the regularity of the successive groups of impressions at the sides; in reference to which the track of Limulus might be named if it were a fossil, "*Ichnites quatuor-notatus*;" and it is to be observed that in Limulus the regularity of the impressions results from the use of a pair of limbs divided into several strong points at their free extremities. The principal difference is in the lateral grooves, which do not appear in Protichnites, and in the less proportionate size of the impressions of the feet, and the smaller number in each series. It is however to be observed, that my specimen was a small animal, giving an impression only 4 inches wide, and that a full grown

female of the American Limulus would give a track fully nine inches in width, and much stronger in the principal impressions, while in such a large track the minor impressions of the anterior feet would also be more distinct.

When the Limulus creeps on quicksand, or on sand just covered with water, so that its body is partly water-borne, it appears principally to use its ordinary walking feet, and the footprints then resolve themselves into a series of longitudinal scratches after the manner of *Protichnites lineatus*, while the lateral and median grooves retain their distinctness, the former being apparently even of greater proportionate depth than on firm sand. This kind of impression is represented in Fig. 2.

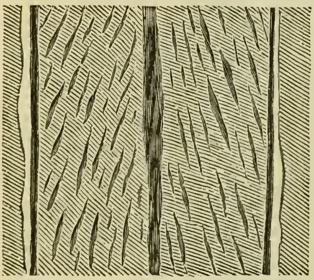


Fig. 2.

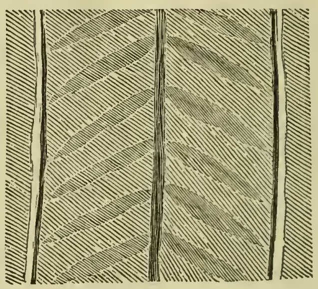


Fig. 3.

When placed in shallow water, just covering the body, the creature used its flat abdominal swimming feet, and though the impression made was very faint, and not readily observed under water, it was obviously very different from those before mentioned, agreeing with them only in the lateral and median grooves, while between these were series of furrows extending obliquely from each side of the middle groove, and resembling ripple marks. (Fig. 3.) These were produced by the sand swept up by the swimming feet. The appearance was not unlike that of the impressions found by Dr. Wilson in beds containing protichnites, and recently described by Sir W. E. Logan in this Journal, under the name *Climactichnites*, except that in the track of Limulus the lateral and medial lines are furrows instead of ridges. The supposition in respect to *Climactichnites* has been, that it is possibly the track of a gasteropod, or of an annelide; but my recent observations of Limulus show that it *may* have been produced by a crustacean moving by broad swimming feet, having a median notch like that in the largest pair in Limulus. To pro-

duce all the appearances observed in the climactichnites, it would be necessary that the animal should not trail its tail along the sand, and that the swimming feet should be broad and powerful, and have considerable mobility from side to side. I may also state that at Orchard Beach I was puzzled for some time by small climactichnite-like tracks on the beach, and at length ascertained that they were made by a large beetle * which occasionally settled on the wet sand, and crept for some distance on its surface, apparently making the transverse tracks by means of its tarsi.

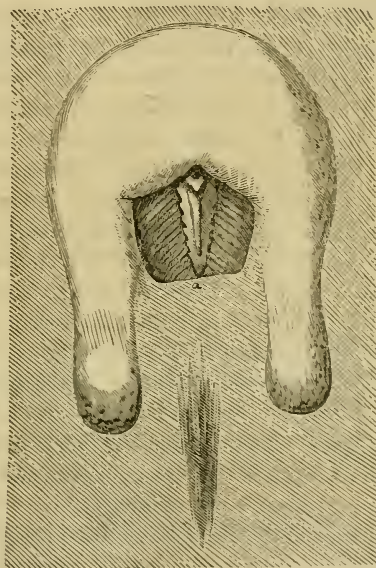


Fig. 4.

The Limulus burrows in soft sand with great ease. It inserts the sharp anterior edge of the cephalo-thorax under the sand like a plough-share, and labouring vigourously with the broad toes of the posterior thoracic feet, throws out sand behind, while it penetrates more deeply in front, at the same time jerking the caudal spine. When nearly buried it presents the singular appearance represented in Fig 4. When it has completely buried itself, it slightly elevates the body and causes the sand to fall off on all sides, so that when it subsides, only a very slight, smooth elevation marks the spot where it is concealed. The form of the ce-

* I suppose *Melolontha (Polyphylla) variolosa.*

phalo-thorax in the Limulus is evidently related to this operation of burrowing, and as in many trilobites it seems even better adapted for such a use, it is probable that they also were burrowers, which would however suppose the existence of strong feet similar to those of Limulus.

From the foregoing observations we may, I think, safely deduce the following inferences respecting Prothichnites:

(1). The conjecture of Owen that they may have been made by a creature somewhat resembling Limulus, is verified by the impressions made by that animal.

(2). The further view of Owen that the grouping of the impressions depended on multifid limbs, and that the number of impressions in a group might indicate specific diversity, is also vindicated by the facts, with this limitation, anticipated by Prof. Owen, that tracks like *P. lineatus*, might have been made by any of the animals which made the other impressions, and that if like Limulus they possessed one large pair of feet making the principal marks, and smaller ones occasionally used, the numbers of marks may have somewhat differed in different circumstances. Still it is evident that a species of Limulus having a different number of divisions of the posterior toes, from that to which these remarks relate, might be distinguished by its footprints.

(3). The animal or animals producing the Protichnites probably resembled Limulus in general form, and in the possession of a strong caudal spine. They probably differed from Limulus in the less breadth or depth of the cephalo-thorax, and in the greater complexity and comparative size of the feet.

(4). Some at least of the Protichnites were probably produced by animals creeping on wet sand; but *P. lineatus* and the *Climactichnites*, if the work of a similar animal, were formed under water. This accords with the view entertained by Sir W. E. Logan as to the conditions of deposition of the Potsdam sandstone; and it is probable that these ancient crustaceans, like the modern Limulus, frequented the sandy beach for the purpose of spawning, and may sometimes have been left dry by the tide.

(5). The suppositions above stated would account for the absence or rarity of remains of the animals which produced the Protichnites. It is rare to find on the modern beach any fragment of an adult Limulus, except on the dry sand above high water mark. The creatures are driven on shore only in storms, and then, owing to the lightness of their crusts, are drifted high on the beach. Their remains are probably to be found in cir-

cumstances favourable to their preservation, only on the muddy bottoms at a distance from the sandy shore. Young individuals only appear to frequent the sand in summer, and occasionally to be imbedded in it.

(6). If we enquire what animals, known to palæontologists, have produced the Protichnites, it would seem that no others fulfil the necessary conditions in any particular, except the larger trilobites, for instance those of the genus *Paradoxides*. It is true that we know nothing as yet of the feet of these creatures, but it seems almost certain from analogy that they must have possessed such organs. Nor have these trilobites a caudal spine like that of Limulus; but here again Mr. Billings points out to me that the pygidium of Paradoxides is narrow and spine-like, though I should think not sufficiently so to form the very distinct median groove of Protichnites, unless indeed the creature was in the habit of walking with this organ pointed downward. On the whole we may safely conclude that if any of the larger primordial trilobites were provided with walking and swimming feet of the type of those of Limulus, but differing in details of structure, they may have produced both the Protichnites and the Climactichnites. On the other hand, it is quite possible that these impressions have been formed by crustaceans yet undiscovered, and approaching in some respects more nearly to Limulus than any of the known trilobites. In this last case I should suppose that the animal in question had a flatter or more shallow cephalo-thorax than that of Limulus, proportionately stronger and perhaps more divided feet, and a stouter caudal spine.

It is scarcely necessary to observe that the footprints of Limulus differ materially from those of the higher crustaceans, and also from the galleries formed by many small burrowing crustacea. With these last Mr. T. Rupert Jones, in an interesting article in the "Geologist" for April, seems disposed to compare *Climactichnites Wilsonii;* but this appears to me to have more the character of a surface impression, though what appear to be galleries of small crustaceans are also found in the Potsdam sandstane. The "*Nereites*" of Emmons,* from the Taconic rocks of that author, also resemble in some respects the sub-aquatic trails of Limulus, and may be the work of Trilobites; and the same remark applies to some of the markings from the Clinton of New York, figured by Hall,† and referred to crustacea and worms.

* Agriculture of New York, Vol. I.

† Palæontology of New York, Vol. II, Pl. 13 to 16.

ARTICLE XXVII.—*On the destruction of Apple-trees by* Saperda candida *in Districts surrounding Quebec.* By WILLIAM COUPER, Quebec.

I have been frequently told that apple-trees will not prosper in the districts surrounding Quebec; the reason is stated to be long, severe winters. "In ascending the flank of the hill, (St. Hilaire,) fine orchards of apple-trees were once more observed on the poor granitic gravels, and many of the trees were loaded with fruit. The apple trees do not thrive on the clay soils of the flats of the St. Lawrence, in consequence, I suppose, of their tenacious nature, while good orchards are met with throughout the island of Montreal, where the soil rests upon the limestone, and is more friable."—*N. America, its agriculture and climate, by R. Russell.*

I have quoted the above to show how conflicting opinions are published without proper investigation. I know little regarding the chemical properties of the clay soils or flats of the St. Lawrence, but am informed that apples were at one time produced in large quantities in the Quebec districts.

I have taken the following extract from the Montreal correspondent of the Toronto *Globe*, June 13:—

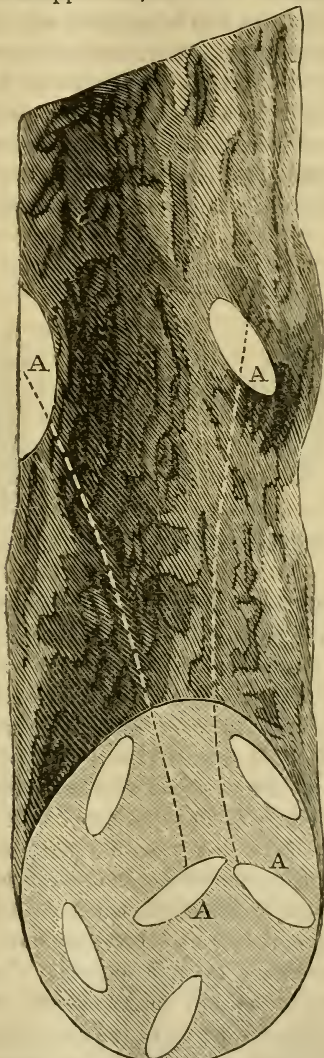
"I regret to say that there is a poor prospect of fruit this year. Apple, pear, and plum-trees are decaying, as they have been for three years back, caused, it is alleged, by severe frost, and the caterpillars swarm in the orchards."

In my entomological excursions into these districts, I captured the insect which is considered the chief cause, and lost no time in visiting several gardens to examine the trees. The gardeners informed me that the trees were invariably imported from the United States, hence, the insect has been introduced within the young trees from our neighbours' nurseries. I rest satisfied regarding the introduction into Canada of this tree-borer, and will state one reason, that during a residence of seventeen years in Toronto, I never captured the insect; nor will it fill a place in the Upper Canada fauna while they depend on their own nurseries for young trees.

In a garden on the north side of the Beauport road, upwards of twelve trees contained the insect, and had to be taken up, thus affording me an opportunity of cutting them up to obtain their destroyers. In doing so, I discovered what I think is new in entomology, i. e., that in trees containing males no opposite sex were found, and those that contained females had that sex only. The illustration is a fac-simile of a young tree cut off at the

trunk, close to the earth. AA are holes from which I procured the perfect beetles.

"The borer of the apple-tree, a white worm or grub, devours



A young Apple-tree showing the holes bored by the larvæ of *Saperda candida*. Fab.

the fragments of wood it gnawed in making its cylindrical path within the trunk of the tree, and pushes the undigested refuse

out of the hole by which it has entered. When fully grown it becomes a pupa, which like the door-bug, exhibits short folded legs, wings and horns, of no use to it while within its burrow. Early in June, the pupa-skin is ruptured, and the insect emerges from the tree by gnawing through the thin covering of bark that protects the upper extremity of the hole. Upon issuing into the air it is found to be a beetle,* white beneath, and longitudinally striped with brown above. In this, its perfect state, it lives only upon the young and tender leaves of the apple and other allied trees."—T. W. Harris, *in N. E. Farmer, vol. II.* 1833.

1

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Fig. 1. *Saperda candida.* Fig. 2. *Larvæ of Same.*

The above is all that was known of this borer when Mr. Harris wrote in 1833, yet his knowledge of the insect was sufficient to cause the apple growers at that time to look out and prevent its extension. It is from carelessness and inattention that this insect is now found in every apple-growing State in the Union. In 1825 an orchard in the neighbourhood of Troy was injured by this *Saperda* to the extent of two thousand dollars.

The Natural History of New York, vol. V., p. 120, states that the *Saperda candida* is three years in coming to maturity. I have reason to doubt the length of metamorphosis here given by Mr. Emmons, who is not considered an entomological authority—the above book being full of errors. From my own observations, the metamorphoses are gone through annually, that is to say, the *arva* casts its skin periodically for 12 months, the insect appearing in June, and the *ova* deposited in June. The fact of the beetle being "more abundant some years than others," as stated by

* Say, the American entomologist, described this insect as *Saperda bivittata*, two longitudinal stripes running from the thorax to end of elgtra. The Fabrician name is preferable on account of priority.

Emmons, is conclusive evidence that the deposition of the eggs was attended with congenial weather. Any person who has studied the habits of forms constituting the Longicorn family, will hold with me as to the strong parasitical attachment of the parent insects to their favourite plants, while propagating their species; and we have hundreds of instances where insects only take a few weeks to complete their stages, being some years scarce, while at other times so common as to overrun the country.

The *Saperda candida* or apple-tree borer, becomes perfect in the neighbourhood of Quebec, on the 9th of June, and continues to issue from the trees up to the 12th or longer; therefore, the trees should be carefully examined and protected as hereafter specified, during the whole of the above month. The insect invariably deposits its eggs at the base of the tree, where it enters the earth; the larva cuts its way obliquely upwards, cross-cutting the circulation of the sap, and depriving it of its nourishment.

The following instructions should be carried out to ensure success in exterminating the borer:—

1. Import no more young apple-trees from the United States, without a thorough examination for the larva. It would be preferable to obtain them from the Upper Canada nurseries where the insect does not occur.

2. Mix an earth-mortar or clay such as is used for grafting purposes, and with it surround the lower part of the tree, say $1\frac{1}{2}$ or 2 feet. It should have a thickness of $1\frac{1}{2}$ or 2 inches, and made to adhere closely to the earth where the trunk enters it. Apply it also from the 1st of June to any of the attacked trees showing symptoms of life. If there are any perfect insects to issue, escape will be cut off, and much good done in this way. It is useless to use solutions of any kind, as the larva ascend the tree and will remain untouched.

3. It would be advisable to use the same precaution with pear trees during this period, as the apple-borer may select them when deprived of its more congenial tree.

ARTICLE XXVIII.—*Discovery of Microscopic Organisms in the Siliceous Nodules of the Palæozoic Rocks of New York.*

At Prof. Dana's suggestion, Dr. M. C. White, well known for his devotion to the microscope, has examined various specimens of the hornstone nodules found in the Devonian and Silurian

rocks of this country, with a view to determine the presence of organisms analogous to those well known to exist in the flints of the Chalk. This research has been rewarded by the discovery of abundant organisms referable to the Desmidieæ, besides a few Diatomaceæ, numerous spicula of sponges, and also fragments of the teeth of Gasteropods. Among the Desmids, there is a large variety of forms of Xanthidia supposed to be the Sporangia of Desmids, besides an occasional duplicated Desmid; also lines of cells, some of which appear to be sparingly branched. The researches have been mostly confined to the hornstone of the Corniferous limestone; though extended also to the hornstone from the Black River limestone and that of the sub-Carboniferous limestone of Illinois, both of which contain some organisms.

The hornstone nodules from the Black River limestone (as well as the Corniferous) have been since examined also by Mr. F. H. Bradley with similar results.

These observations will be regarded with much interest by geologists as well by miscrocopists. They carry back to a very early epoch forms of life which have hitherto been looked upon as belonging only to a much more recent era in the life of our planet.

The analogy of these hornstone nodules to the flints of the Chalk is obvious; and the discoveries here anounced may be regarded as establishing their similarity in origin. The organisms figured so closely resemble those of the flint that they might be taken for them; it is difficult in all cases to make out a difference of species.

The extreme abundance of the hornstone nodules in our palæozoic limestones will render it easy to multiply observations in this new field of research, which presents an interesting addition to the labors of the microscopist. It will be remembered by those who undertake such examinations that the use of turpentine renders the chips of chert almost as transparent as glass.—

To THE EDITORS,—Having recently been engaged in examining the microscopic structure of hornstone from Palæozoic rocks, I send you the accompanying sketches of organic forms which I have discovered. They consist of spicules and gemmules of sponge and fragments of sponges; Desmidieæ, several species of Xanthidia, and disks which probably are to be considered as Diatoms. Hornstone from the corniferous limestone of central and western New York contains the greatest variety of these organic forms. A few specimens have been found in hornstone of the Black River Limestones from Watertown, N. Y. * * * *

* * * * * * * * * * * * * * * *

These investigations were undertaken at the suggestion of Prof. Dana, who furnished the specimens of hornstone, the examination of which has enabled me to make these most interesting discoveries. Yours, &c. M. C. WHITE.

New Haven, Conn., March 22, 1862.—*Am Jour. of Science.*

[We commend the above interesting discovery to the notice of microscopists in Canada. Some of our oldest limestones and cherts, as for example those of the limestones of the Quebec group, present a microscopic appearance similar to that of ordinary flint, and contain numerous minute fragments and globular and spicular bodies, some of which may probably be of the same nature with those discovered by Dr. White, though we have not as yet been able to satisfy ourselves of their organic character. EDS.]

ARTICLE XXIX.——*List of Orthoptera collected on a trip from Assiniboiâ to Cumberland.* By SAMUEL H. SCUDDER.

The species enumerated below were obtained during a canoe trip, taken during the summer of 1860, from the Red River settlements to the Pas on the Saskatchewan River, and during a few days stay at Fort Garry at the former place. The collections made were small in number both of individuals and of species, because of the meagre opportunities given for collecting upon a hurried trip of this nature, but are interesting because of having passed—so far as the trip extended—over the exact route, taken by Sir John Richardson when making the collections which formed the basis of Kirby's work on the Insects of Boreal America. I have been enabled to determine, with but the least degree of doubt, the few *Orthoptera* described by him, which since his day have been involved in obscurity. This list lays no claims to completeness, but as being an advance on anything hitherto known, it is offered with the hope that by exhibiting to others the meagreness of our knowledge of the Orthopteran fauna of the great North-West, it may stimulate increased activity in this interesting department, where so much remains to be done. Collections from every portion of the British Provinces are earnestly solicited by the author, the most common no less than the uncommon species, in return for which he will be glad to furnish labelled series of collections sent, or of species found within the limits of New England.

Cambridge, Mass. July 8th, 1862.

PHASMIDÆ—Leach.

DIAPHEROMERA, Gray.

D. FEMORATA.

Spectrum femoratum, Say, App. Long's Second Exp. 297.

Diapheromera Sayi, Gray, Synopsis of Phasmidæ, 18.

Bacteria (*Bacunculus*) *Sayi*, Burm. Handb. d. Ent. II, 566.

A single specimen was brought to me at the Selkirk settlements on Red River. I have seen specimens also from Massachusetts, N. Hampshire, Illinois, and Nebraska.

LOCUSTARIÆ—Latreille.

UDEOPSYLLA, Scudd.

This genus is to be placed between *Ceuthophilus*,* Scudd. and *Daihinia*, Hald. The maxillary palpi are rather long: the first and second joints equal and small; third more than equal to the preceding together; fourth little more than half as long as third; fifth a little longer than third, somewhat curved, split along the whole under side. As in *Ceuthophilus* the pro- meso- and meta-nota nearly conceal the epimera of the thoracic segments. Hind femora very heavy, thick and especially broad, but not so much so as in *Daihinia*, where, as in this genus, the whole limb is swollen, and not the basal portion only, as in the neighboring genera; it differs from *Daihinia* in the structure of the tarsal joints, which here have the first and fourth joints equal and longest, the second and third equal and small, the second overlapping the third above.

Daihinia robusta, Hald. is the type of the genus, a species found in Nebraska.

U. NIGRA, nov. sp.

Shining black, with a faintly indicated, narrow, reddish, dorsal line, a reddish tinge on the front of the face, the basal half of the inner surface of hind femora, and the terminal half of the ovipositor reddish; the hind femora of the male have upon either edge of the under surface, but especially on the inner, short but heavy spines, not crowded, the hind tibiæ are furnished on either edge of the upper surface with four or five opposite, long and slender spines, between each two of which are placed three or four suppressed spines; there is a single row of short spines upon the

* *Ceuthophilus* is a new genus, of which *Rhaphidophora maculata*, Harr, is the type, for full characteristics of this and *Udeopsylla* see an article on N. American Orthoptera, presented to the Boston Society of Natural History in May, 1862, and now publishing in their Journal, Vol. VII, No. 3.

under surface, which become double towards the tip; the inner valves of the ovipositor have five teeth growing longer and more curved towards the tip, where they are very long and slender.

Length of body, .8–9 in.; of hind femora, .68 in.; .56 in.; of ovipositor, .33 in.; of antennæ, about 1 in.

This species was taken by Mr. Kennicott at Red River, and I obtained it in northern Minnesota, upon the Red River trail, leaping about in the grass, at mid-day.

PHANEROPTERA, Serville.

P. CURVICAUDA, Serville, Ann. Sc. Nat., 1st ser. XXII, 159.

Locusta curvicauda, De Geer, Mem. III, 446, Pl. 38, fig. 3.

Gryllus (*Phyllopterus*) *myrtifolius*, Drury, Ill., Ex. Ent. (Westwood's edition) II, 88, Pl. 41, fig. 2 (Syn. del.).

Phaneroptera angustifolia, Harris, Report Ins. Mass., 3d edition., 160, fig. 76.

This species varies very much in size and in the proportions of the wing-covers. I obtained it at Red River, and have seen it also from most of the N. England states, where it is somewhat abundant.

[I enclose the two succeeding species in brackets, because I have very strong doubts whether the specimens obtained by me are referable to the species mentioned, and I only place them there now in order to indicate their affinities.

XIPHIDIUM, Serville.

X. FASCIATUM, Serv., Ann. Sc. Nat., 1st ser. XXII, 159.

Locusta fasciata, De Geer, Mem. III, 458, Pl. 40, fig. 4.

Orchelimum gracile, Harris, Rep. Ins. Mass. 3d ed. 163, fig. 78.

I have this species in large numbers from New England; those obtained at Red River differ from these in having a larger body, and a longer ovipositor.

X. BREVIPENNIS, nov. sp.

This species as found in New England may be characterized thus:

Size of *X. fasciatum*, with which it agrees in coloration throughout, except that the wings are a little darker, the dorsal band is a little broader and is of a reddish brown throughout, while in *X. fasciatum* it is green at the base: wings .08 in. shorter than the wing covers, both shorter than the body; ovipositor nearly equalling the hind femora in length: in these respects it differs very much from *X. fasciatum*.

Length of body, .5 in.; of wing covers .33 in.; of hind femora .43 in.; of ovipositor .4 in.

The single specimen I have from Red River is smaller than any I have seen elsewhere, has no wings, and the wing covers but .14 in. in length.]

ACRYDII—Latreille.

CHLOEALTIS, Harris.

C. CONSPERSA, Harris, Report Ins. Mass., 3d Ed. 184.

C. abortiva, " " " "

This species was obtained in abundance on the 4th July, at Dog's Head, eastern shore of Lake Winnipeg, leaping about actively when disturbed, and apparently living exclusively among the lichens which bordered the patches of rocks.

STENOBOTHRUS, Fischer Fr.

S. CURTIPENNIS.

Chloëaltis curtipennis, Harr., Report Ins. Mass. 3rd ed. 184 pl. 3, fig. 1.

This species, which is one of the commonest N. England forms, was found abundantly at the Red River settlements. The figure in Harris' Report is quite inaccurate.

ARCYPTERA, Serville.

A. GRACILIS, nov. sp.

Vertex of the head rather broad, swollen at front border of the eye, the edge raised to a ridge, with a medial ridge extending over the whole top of the head; foveolæ long and narrow, triangular, rather deep; pronotum rugose; wing covers short and broad, costal border somewhat swollen near the base, internal border full.

Dark brown; a narrow curved dark line extends from the upper border of the eye to the lateral carinæ of the pronotum, and is the inner limit of a rather broad brownish-yellow band, which extends from the hind border of the eye to the lateral carinæ, whence it continues backwards crossing the carinæ; below this upon the upper border of the sides extends a narrow black band from the eye to the hind edge of pronotum; the medial carina is black; wing-covers uniform dusky brown, except the internal border, which is yellowish brown; wings dusky, with a yellowish tinge on the internal half; hind femora reddish, black at apex; hind tibiæ yellow with black spines, with the base and apex black, and a dark annulation at the upper limit of the spines.

Length of body ·85 in.; of wing-covers ·78 in.; breadth of wing-covers in middle ·22 in.; length of hind femora ·52 in.

This species seemed to be rather abundant at Red River. I know it elsewhere only by a single specimen from Maine.

PEZOTETTIX, Burmeister.

P. BOREALIS, nov. sp.

Vertex of the head with a broad longitudinal furrow in advance

of the middle of the eyes; sides of pronotum very nearly parallel, slightly wider at hind border, which is arcuate; medial carina slightly higher than the lateral, not prominent; wing-covers longer than the wings, not quite reaching the extremity of the abdomen.

Dark brown, darkest above; a broad black band behind the eye, extending over the upper portion of the sides of the pronotum to the hind border; front dark yellowish brown, mouth parts dirty yellowish; legs yellowish brown; hind femora streaked with black, with the apex black; hind tibiæ reddish, with a faint paler annulation near the base, the spine tipped with black; wing-covers dirty yellowish brown, spotted irregularly with darker brown; wings colorless, a little dusky on costal border.

Length of body ·65 in.; of wing-covers ·4 in.; of hind femora ·4 in.

This species is fond of places where the grass grows thinly. I obtained specimens at the Pas on the Saskatchewan River, and at different points along Lake Winnipeg. I have also seen mutilated specimens, doubtless of this species, from the Island of Anticosti in the Gulf of St. Lawrence.

Caloptenus, Serville, (emend).

C. femur-rubrum, Burn. Handb. d. Ent. II. 638.

Acrydium femur-rubrum, DeGeer, Mem. III. 498 Pl. 42, fig. 5.

Acrydium femorale, Oliv. Encyc. Meth. IV. 228.

This is a wide spread and exceedingly abundant species. I found it in considerable quantities at Red River, and I have specimens also from Minnesota, Illinois, Nebraska and N. England.

C. bivittatus, Uhler in Say's Ent. of N. Am., ed. Leconte, II. 238.

Gryllus bivittatus, Say, Journ. Ac. Nat. Sc. Phil. IV. 308.

Locusta leucostoma, Kirby, Faun. Bor. Am. IV. 250.

Caloptenus femoratus, Burm. Handb. d. Ent. II. 638.

Acrydium flavovittatum, Harris, Report Ins. Mass., 3rd ed. 173.

I found this species in considerable abundance in grassy places along the shores of Lake Winnipeg, particularly near the mouth of the Saskatchewan. It is a wide spread species; for I have seen specimens from as widely separated localities as Maine, Maryland, Texas, Nebraska, Illinois, Minnesota, and Lake Winnipeg.

Œdipoda, Latreille.

Œ. æqualis, Uhl. in Harr. Report Ins. Mass., 3rd ed. 178.

Gryllus æqualis, Say, Journ. Acad. Nat. Sc. Phil. IV. 307.

This species was not found farther north than the southern shore of Lake Winnipeg. I have taken it also in Minnesota and N. England.

Œ. verruculata.

Locusta verruculata, Kirby, Faunn. Bor. Am. IV. 250.

Locusta latipennis, Harr. Report, Ins. Mass., 3rd ed. 178.

I found this species at Pt. Wigwam, Lake Winnipeg, on 1st August, abundant at mid-day flying about on the sandy spots, like the preceding species it makes a crackling noise with every successive flutter of its wings. I have seen it elsewhere only from N. England.

Uhler, (Harr. Report Ins. Mass., 3rd ed., 178,) considers this to be identical with the previous species, in which opinion I can hardly concur—it differs from *Œ. æqualis* in the following particulars: in *Œ. æqualis* the black band across the middle of the wings is broad, its outer edge as well as the inner distinct, the outer border at first straight, then well rounded, curving inwards where it approaches the outer border; beyond the band the wing is pellucid with black veins not cloudy, and at the tip there is either a dusky patch, or irregularly clustered square blackish spots; in *Œ. verruculata* the inner border of the band is more wavy and is illy defined; the outer border is straight, and where it approaches the outer border of the wing is turned slightly outwards instead of inwards, and is frequently very indistinct, being merged into the more or less dusky space beyond it, which increases in cloudiness to the tip, where it is as dark as the band; the band itself is quite narrow in the middle, so that it might be said to be made up of two triangular patches which meet and merge in the middle; the broadest band I have seen in *Œ. verruculata* is not more than half the width of the narrowest I have observed in *Œ. æqualis;* in *Œ. æqualis* the hind tibiæ are either wholly coral-red, or have a pale yellowish annulation at the base; in *Œ. verruculata* the tibiæ have the base and apex black, with the middle half yellowish, with generally a dusky annulation in the middle.

Tetrix, Latreille, (emend).

T. granulata.

Acrydium granulatum, Kirby, Faun. Bor. Am. IV. 251.

Tetrix ornata, Harris, Report Ins. Mass., 3rd ed. 186.

(Not *Acrydium ornatum*, Say, Am. Ent. I. Pl. V.)

I have not seen this species from British America, but only from northern Minnesota, on the Red River trail, and from N. England, but mention it here because of its having been first described by Kirby. It is not the species described by Say under the name of *ornatum*, although it is closely allied to it—it differs from *ornatum* in the longer extension of the pronotum backward, its greater size, and in the prominence of the vertex, which is angulated in front—it varies much in coloration.

ARTICLE XXX.—*On the Mammals and Birds of the District, of Montreal.* By ARCHIBALD HALL, M.D., L.R.C.S.E.

(*Continued from page* 193.)

Turdus noveboracensis. Aquatic Thrush.
T. aquaticus of Audubon !
Sylvia noveboracensis. Latham and Buonaparte !!

V.S.P. Legs and bill brown ; irides black ; bill slightly notched ; eggs 4 to 5, flesh colour, spotted dark towards the larger end.

Dorsal aspect. Olive brown, with a ring of a lighter tint round the neck.

Ventral aspect. A line from the nostrils over the eye, terminating beyond the auriculars of a cream colour ; auriculars pale brown ; sides of the neck, throat, breast, belly, vent, and tail coverts yellowish white, thickly spotted with brown streaks, most numerous and largest on the breast, and finest on the throat.

2nd and 3rd primaries subequal and longest ; 1st longer than the 4th. Length 5½ inches ; alar breadth 8 inches. The female differs little.

T. aurocapillus. Golden-crowned Thrush.
Sylvia aurocapilla of Buonaparte !
Seirus aurocapillus. Baird !

V.S.P. Bill short, and with the legs pale flesh colour ; irides hazel ; eggs 4 to 5, white mottled with reddish brown.

Dorsal aspect. Olivaceous yellow ; crown brownish orange, with a lateral border of black from the nostrils, lost upon the occiput, succeeded by the dorsal tint immediately above the eye ; primaries and secondaries ashy, edged with whitish.

Ventral aspect. Pure white with black spots on the sides of the neck, breast and flanks ; inner wing coverts pale yellow ; eyelids white.

1st, 2nd, and 3rd primaries equal. Length 6 inches ; alar breadth 9 inches.

Genus Tanagra.

Gen. char. Bill short, robust, triangular at the base, carinate ; upper mandible curved and notched wider than, and projecting over, the lower one ; lower one straight, somewhat gibbous towards the middle ; nostrils basal, round, and open ; tarsus equal to the middle toe ; external and middle toe connected at base ; 2nd and 3rd primaries longest.

T. rubra. Scarlet Tanager.

Pyranga rubra. Linn.! Viell.! Baird!

V.S.P. Bill horn coloured, black at the base; legs and feet bluish; irides deep hazel; according to Nuttal "cream colour," which I never observed, although I have inspected upwards of a hundred specimens. Eggs 3 to 4, dull blue, mottled with brownish purple towards the larger end.

Dorsal aspect. Scarlet, varying in depth of tint from the brightest to an orange; wings and tail black, the latter emarginate.

Ventral aspect. Scarlet, paler about the vent.

2nd primary longest; 1st a little shorter than the 3rd. Length 6¾ inches; alar breadth 11 inches. The young bird has some touches of green about it, especially among the scapulars, and the ventral aspect inclines to a yellowish tinge.

T. æstiva. Summer Redbird.

Pyranga æstiva. Gmel.! Linn.! Viell.! Baird!

V.S.P. Bill horn coloured, whitish where the mandibles meet; legs and feet greyish blue; irides hazel; eggs 4 to 5 light blue.

Dorsal aspect. Crimson; wings light brown, the edges of the outer vanes margined with greenish yellow; tail composed of 12 feathers; the two external ones greenish yellow, the middle ones crimson.

Ventral aspect. Crimson.

Length from extremity of tail to beak 7½ inches; alar expanse about 9½ inches.

This is a beautiful bird but very rare. In all my rambles I never met with it. The specimen before me, and which I have described, is a young bird, shot by Mr. Hunter, taxidermist to the Natural History Society, on the mountain. He was accompanied by an associate which Mr. Hunter could not succeed in obtaining. The old bird differs from the young one in having, according to Audubon, "the tips and inner webs of the quills tinged with brown."

The adult female differs essentially from the male. Thus according to the same authority, "the general colour above is light brownish green, the sides of the head, and the under parts generally are brownish yellow; large wing coverts dusky edged with yellow; quills deep brown, externally margined with yellowish red; tail feathers of the same colour." This with its congener are our two most flashy birds.

Genus Quiscalus.

Gen. char. Bill moderately long, compressed, entire, with sharp and inflected edges; upper mandible projecting over the lower, and extended backwards on the forehead; nostrils oval, half closed by a membrane; outer and middle toe connected at the base; 2nd and 3rd primaries longest; tail more or less rounded.

Q. versicolor. Purple Grackle.
Gracula quiscala.
Quiscalus versicolor. Baird!

V.S.P. Bill, legs and feet black; irides white; eggs 5 to 6 dull green, blotched and spotted with dark olive.

Dorsal and ventral aspects. Black, with a purple or steel blue iridescence on the head and neck; bronze on the belly and back, and bronze and violet on the greater wing coverts and secondaries; primaries black without iridescence; tail rounded almost cuneiform, with steel blue reflections.

3rd primary longest; 1st, 2nd, and 4th subequal. Length 12 inches; alar breadth 17½ inches. Female less brilliant than the male.

Q. baritus. Common Blackbird.
Gracula barita of Linnæus!
Oriolus niger of Gmelin.
Qniscalus baritus. Baird!

V.S.P. Bill, legs and feet black; irides black; eggs 5, dark coloured spotted with dusky.

Dorsal and ventral aspects. Deep black, with a faint steel blue iridescence, inclining to green about the wings; feathers generally faintly tipped with brownish; tail nearly square; lateral feathers on each side shortest; ½ inch shorter than the centre ones.

2nd primary longest; 1st next. Length 9 inches; alar expanse 14½ inches. According to Nuttal the female is dull brownish, with the eyebrows and ventral aspect whitish.

Q. ferrugineus. Rusty Grackle.
Gracula ferruginea of Wilson.
Scoleophagus ferrugineus? Baird!

V.S.P. Legs, bill and feet black; irides white; eggs 5, dusky spotted with black.

Dorsal and ventral aspects. Glossy black, with ferruginous tips to the feathers; head and neck iridescent with dark green.

2nd primary longest; tail rounded. Length $9\frac{1}{2}$ inches; alar expanse 15 inches. The female has the belly and rump ashy.

Genus Oriolus.

Gen. char. Bill conic, horizontally compressed at the base; upper mandible ridged and carinate; nostrils basal, lateral and naked, and horizontally pierced in a large membrane; tarsus and middle toe subequal in length; outer and middle toes connected at base; 2nd primary longest.

O. Baltimorus. Baltimore Oriole.

Icterus Baltimorus. Buonaparte! Baird!

V.S.P. Bill, legs and feet pale blue; irides deep hazel; eggs 4 to 5, bluish white, spotted and streaked with dark brown; nest pendant.

Dorsal aspect. Head, neck, and back deep black; rump orange; tail square, the two central feathers black with minute orange tips; all the lateral ones black with their distal halves orange; smaller wing coverts orange; greater ones black tipped with white on their outer vanes, the three or four last secondaries similar; primaries and the other secondaries black, with faint emarginations of white on their outer vanes.

Ventral aspect. Neck black, terminating in a cone on the lower part of the throat; breast and all the other parts orange.

2nd primary longest; 1st and 3rd very little shorter. Length $7\frac{1}{2}$ inches; alar breadth 11 inches. The female differs considerably from the male. Her dorsal aspect is yellowish brown, with the tail olivaceous; the wing coverts tipped with yellowish; secondaries much more broadly margined with white than in the male; head of the dorsal tint. Ventral aspect yellowish.. Taken from a living female in the author's possession; her second moult. The winter plumage is the same as the summer.

Family II. Fissirostres.

Genus Hirundo.

Gen. char. Bill short, triangular, depressed and wide at the base, and cleft nearly to the eyes; upper mandible notched, and a little hooked at the point; nostrils basal, oblong, semi-closed by a membrane; exterior and middle toes united to the first joint; 1st primary longest; tail more or less furcate.

H. purpurea. The Purple Martin.

Progne purpurea. Linn.! Baird!

V.S.P. Bill, legs and feet black; irides hazel; eggs 4 to 6, white.

Dorsal and ventral aspects. Prussian blue, with purplish steel reflections; tail furcate, and as well as the wings sooty brown.

1st primary longest. Length 9 inches; alar breadth 16½ inches. The female is greyish on the ventral aspect, and with the young bird of the first moult is altogether not nearly as brilliant in appearance.

H. rufa. The Barn Swallow.
H. Americana. Wilson!
H. horreorum. Barton! Baird!

V.S.P. Bill black; legs and feet purplish black; irides hazel; eggs 4, white spotted brown.

Dorsal aspect like the last; frontlet ferruginous.

Ventral aspect. Throat ferruginous; breast covered by a purple band; belly, vent, wing and tail coverts of a pale ferruginous tint.

Tail deeply furcate; lateral feathers twice as long as the centre ones, and all spotted with white on their inner webs, presenting a crescentic band which is most conspicuous on the lower surface; wings and tail feathers brownish black; 1st primary longest. Length 6¼ inches; alar breadth 12¼ inches. The female has the belly and vent rufous white.

H. bicolor. White-bellied Swallow.
H. viridis. Wilson!

V.S.P. Bill, legs and feet blackish; irides hazel; eggs 4 to 5, white.

Dorsal aspect. Blue, with purple reflections.

Ventral aspect. White, inclining to greyish on the flanks; tail subfurcate; wings sooty brown.

1st primary longest. Length 5¼ inches; alar expanse 11 inches. The female and young resemble the male.

H. fulva. Cliff Swallow.
H. lunifrons. Say! Baird!

D.C. "Blue black; beneath brownish white; throat and rump ferruginous; front with a paler semilunar band; tail even; tail coverts pale yellowish red; wings and tail brownish black. Length 5⅓ inches; alar extent 12 inches."—(Nuttall).

Genus Caprimulgus.

Gen. char. Bill slender, short, depressed, and cleft beyond the eyes; upper mandible generally furnished with long bristles; slightly hooked; nostrils basal, wide, more than half closed by a

feathered membrane, having a tubular opening; anterior toes united as far as the first joint; middle claws long and pectinate; hind toe versatile; 2nd and 3rd primaries longest.

C. vociferus. The Whip-poor-will.
Antrostomus vociferus. Wils.! Buonap.! Baird!

V.S P. Bill black; legs and feet whitish; irides deep hazel; eggs 2, bluish white blotched with dark olive.

Dorsal aspect. Feathers of the head and back minutely speckled with brown and white, with black streaks along the shafts; a ferruginous tint prevails on the scapulars and coverts, the former of which are broadly tipped with black; tail round; the three lateral tail feathers white on their distal halves; the others speckled and barred with black, brown, and ferruginous; primaries and secondaries brown, speckled with ferruginous towards their extremities; with ferruginous spots, causing bars on the outer and inner vanes of both.

Ventral aspect like the dorsal; a narrow white line traverses the throat, and a pale ferruginous tint prevails on the abdomen, though much intermingled with black; vent feathers and inner tail coverts pale ferruginous.

2nd primary longest; 3rd next; 1st a little longer than 4th. Length 10½ inches, alar breadth 19 inches; middle claw pectinate on its inner margin. The female has the white parts of the male pale ochreous.

C. Virginianus. Night Hawk or Mosquitoe Hawk.
Chordeiles popetue? Baird!

V.S.P. Bill black; feet and legs blackish; irides deep hazel; eggs 2, bluish white mottled with umber colour.

Dorsal aspect. Glossy brownish black, speckled with numerous small spots, and narrow zigzag bars of a pale grey or cream colour; the cream colour predominating on the scapulars; wings brownish black, tipped with soiled white, and intersected on the five first primaries by a white spot forming a band; the white spot obsolete on the outer vanes of the 1st; tail furcate, blackish brown barred with grey. "In the male there is a white band on the tail."—(Nuttall).

Ventral aspect. A white spot on the throat; breast, belly and vent dirty cream colour, barred with blackish brown; the bars lorgest and most distinct on the belly; most numerous and least distinct on the breast and chin.

1st primary longest. Length $9\frac{3}{4}$ inches; alar breadth 22 inches.

C. Americanus, Linn.!

V.S.P. Bill and legs pale flesh colour; the former black towards the tip; irides hazel.

Dorsal aspect. Prevailing tint a light coloured brown or fawn colour, intersected on the crown of the head by a narrow black streak; feathers of the occiput minutely powdered with light fawn; those of the neck with a black bar tipped with cream colour; scapulars brown, distal halves of their outer vanes black, with cream coloured edges and barred below the surface; small wing coverts brown, minutely barred and powdered with black; greater wing coverts brown, barred and speckled with black; a well defined bar towards their extremities, succeeded by a cream coloured tip; tail rounded, lateral feather and quill half of the outer vane of 2nd feather brownish black; the remainder of the outer vanes and whole inner vanes of 2nd, and whole of the 3rd white; centre feathers of the prevailing dorsal tint with 10 to 11 bars of black, and speckled with the same colour in the intermediate spaces; wings brown; the 5 first primaries with a white bar across the outer and inner vanes, not obsolete on the outer vanes of the 1st.

Ventral aspect. A white spot on the throat; breast and chin ferrugineous, barred with black; belly and vent pale ferruginous, barred with dusky.

Bill with bristles projecting about 4 lines beyond the extremity of the bill; legs longer than the C. Virginianus; 1 inch, 3 lines from the knee to the tarsus; middle toe with claw as long as the tarsi, inner edge of the claw pectinate. Length $10\frac{1}{2}$ inches; alar breadth 18 inches. 3rd primary longest; 2nd and 4th equal; 1st a little longer than the 5th.

Described from a specimen in the museum of the Natural History Society of Montreal.

This is a Mexican species, which in its wandering contrived to reach this neighbourhood. It was shot on the mountain by the late Mr. Broome, who held for many years the situation of taxidermist to the Natural History Society. It was identified by Mr. Cassin of Philadelphia, as a Mexican species, under the above designation. *See appendix.*

Family III. Conirostres.

Genus Alauda.

Gen. char. Bill short, conic; mandibles of equal length; upper one convex and entire; nostrils basal, oval, partly concealed by the feathers of the forehead; tongue bifid; toes free; hind claw prolonged, nearly straight, and longer than the toe; spurious feathers short or aberrant; 2nd and 3rd primaries longest; two of the scapulars nearly as long as the primaries; tail furcate; coronal feathers erectile at pleasure.

A. alpestris. Shore Lark.

V.S.P. Bill dusky; legs and claws black; irides hazel; eggs unknown.

Dorsal aspect. Frontlet, and line over and round the eye, ending above the eyes yellow, succeeded on the forehead and sides of the head by black; nape of neck, crown of head, and dorsal region reddish fawn; small wing coverts tipped with white; dorsal feathers with central black streaks; tail square; lateral feathers white on their outer vanes; all the rest blackish brown except the two centre ones which are broadly edged and tipped with fawn verging to white; wings brownish black; secondaries and two or three last primaries edged with whitish, and tipped with the same; outer vane of 1st primary altogether white.

Ventral aspect. Auriculars light brown, a black streak from the angle of the mouth to the cheeks, gradually increasing in breadth; upper part of the throat and sides of the neck yellow; breast with a broad black crescent; abdomen, wing and tail coverts white; vent and sides of the breast fawn.

2nd primary longest; 1st shorter than 3rd, but two lines longer than the 4th. Length 7½ inches; alar breadth 13 inches.

Genus Parus.

Gen. char. Bill short, straight, conic, compressed entire, furnished with nuchal bristles; nostrils basal, rounded, and concealed by the projecting feathers of the forehead; feet with the toes divided; hind claw strongest and most bent; 4th and 5th primaries the longest.

P. Palustris. Black-capped Titmouse.
P. atricapillus. Baird!

V.S.P. Bill black; legs bluish; irides dark hazel; eggs 6 to 12, white speckled with reddish brown.

Dorsal aspect. Crown, occiput, and nape of neck black; auriculars and cheeks white, projecting conically forward to the angle of the bill; dorsal region bluish grey; wings and tail darker, the former edged with whitish.

Ventral aspect. Chin and throat black; the sides white tinted with brown.

Length 5½ inches; alar expanse 6½ inches; head not crested. (Compiled from Nuttal).

Genus Emberiza.

Gen. char. Bill short, compressed, conic, with inflected edges; upper mandible narrower than the under; nostrils basal, rounded, partly concealed by projecting feathers from the forehead; toes divided; hind claw short and bent; tail more or less furcate.

E. nivalis. The Snow Bunting.
Plectrophanes nivalis. Linn.! Baird!

V.S.P. Bill yellowish; legs and feet black; irides deep hazel; eggs 5, whitish mottled with brown and grey.

Dorsal aspect. (Winter plumage as they appear in this district). Crown, occiput, and nape of neck stained with rufous; dorsum interscapular region and scapulars black, the feathers tipped with rufous; greater and smaller wing coverts and rump white; tail coverts black with white tips; spurious wing feathers black; primaries blackish brown, white at their insertion and with white margins on their outer vanes and tips; secondaries, except the four last which have rufous outer margins, white; tail subfurcate, their lateral feathers white with black tips, the rest blackish brown with white margins and tips.

Ventral aspect. White, with rufous stains on the throat, sides of breast and flanks.

1st primary longest. Length 7¼ inches; alar breadth 13 inches. This bird varies considerably in the minor shades which characterize its plumage.

E. lapponica. Lapland Longspur Bunting.
Plectrophanes lapponica. Linn.! Baird!

V.S.P. Bill yellow tipped with black; legs and feet black; irides hazel; eggs 5 to 6, yellowish rusty clouded with brown.

Dorsal aspect. Front, and crown of the head black; nape of the neck rufovs; back, rump, tail coverts and scapulars blackish brown, with broad rufous edging and tips; greater and smaller wing coverts blackish brown tipped with white; tail and quill

feathers black, edged with white on the outer vanes; the lateral tail feathers on the whole of the outer vane, and distal half of the inner vanes, with a tear shaped spot of blackish brown on the extremity of the shafts.

Ventral aspect. Breast, throat, chin, and cheeks black; a white line from the nostrils proceeds along the eye, and soon acquires a yellow tint, and gradually increasing in breadth descends behind the auriculars, and separates the black cheeks from the rufous sides of the neck; belly, vent and tail coverts white; flanks streaked black.

1st and 2nd primaries equal. Length 6½ inches; alar breadth 11 inches; hind claw with nail 11 lines long.

Genus Fringilla.

Gen. char. Bill short, robust, conic, unnotched; upper mandible wider than the lower, gibbous, with the apex slightly inclined; nostrils basal, round, concealed by the feathers of the forehead; tarsus shorter than the middle toe; all the toes free; hind nail longest and largest; wings rounded; 3rd and 4th primaries longest; tail square or subfurcate.

F. cyanea. Indigo Finch.

Cyanospiza cyanea. Linn.! Baird!

V.S.P. ET V. Lower mandible pale; upper one, legs and feet black; irides black or very deep hazel; eggs 5 greenish white without spots.

Dorsal aspect. Sky blue, deepening on the head and neck into a fine ultramarine; back and rump blue, with a verdigris green reflection; greater and smaller coverts black broadly tipped with blue; quills of the wing and tail blackish brown, the former edged with verdigris green, the latter with pale bluish white.

Ventral aspect. Ultramarine on the throat and upper part of the breast, changing to a verdigris green on the abdomen; vent pale brown; tail coverts blue tipped with white.

2nd primary longest. Length 5½ inches; alar breadth 8 inches. The female is flaxen tinged with ferruginous; cheeks and below ferrugineous white; lower mandible almost white. In the winter plumage the dorsal aspect is brown; the feathers internally retaining a bluish tinge. The sky blue is still retained on the shoulders, the wing coverts, and margins of the quills of the wings and tail; chin white, with a fine blue streak from each angle of the mouth, lost upon the breast, which is pale brown with indistinct bluish spots; belly and vent white.

F. nivalis. Snow bird.
F. hudsonia of Wilson!
F. hyemalis of Audubon!
Junco hyemalis. Linn.! Baird!

V.S.P. ET V. Bill and legs pale; eggs 3 to 5, green, spotted and speckled with cinereous; irides black.

Dorsal aspect. Greyish black; wing feathers blackish brown; Primaries edged with white; secondaries with brown on the outer vanes, and all more or less edged with white on their inner vanes; tail square; two lateral feathers, and outer vane of 3rd white; Centre feathers blackish brown.

Ventral aspect. Like the dorsal, except the belly, vent, and tail coverts which are white; wing coverts pale grey, edged and tipped with white.

2nd and 3rd primaries equal; 1st shorter than 5th. Length 7¼ inches; alar breadth 8½ inches.

F. Pennsylvannica. White-throated Sparrow.
F. albicollis of Wilson!
Zonotrichia albicollis. Gmel.! Baird!

V.S.P. Upper mandible bluish horn colour; lower one, legs and feet pale flesh colour; eggs unknown.

Dorsal aspect. Crown and nape of neck black, divided in the centre by a line of white, and bordered laterally by another line of white, which becomes yellow between the nostrils and the eye, and black behind the eye; back with the scapulars blackish brown broadly edged with chestnut; greater and smaller wing coverts brown tipped with white, causing a couple of bars across the shoulders; tail square, long, glossy chestnut, edged with a lighter tint; primaries and secondaries brown, the former edged with whitish, the latter broadly with chestnut.

Ventral aspect. Cheeks, breast, and flanks lead colour, approaching to brown on the last mentioned situation; belly and tail coverts, with a spot upon the throat white.

1st, 2nd and 3rd primaries subequal. Length 6¼ inches; alar breadth 8½ inches; length of tail 2½ inches.

F. melodia. Song Sparrow.
Melospiza melodia. Wilson! Baird!

V.S.P. ET V. Upper mandible bluish horn colour; lower one pale; legs and feet pale flesh colour; eggs 4 to 5, greenish white mottled with brown.

Dorsal aspect. Crown chesnut, divided in the centre by a greyish streak; scapulars blackish brown, broadly edged with chesnut; rump chesnut; tail square, blackish brown along the shafts and broadly edged with chesnut; primaries like the tail; secondaries blackish brown, with broad edgings of chesnut and tipped with the same.

Ventral aspect. A line over the eye as far as the auriculars grey; auriculars chesnut; chin, belly, and vent white; on either side of the throat a triangular spot of blackish brown, and a similar one in the centre of the breast, most conspicuous when the feathers are a little separated; the other parts of the breast and flanks streaked with chesnut.

4th primary longest; 3rd and 5th subequal; 2nd and 6th subequal; 1st equal to 7th. Length 5¾ inches; alar breadth 7 inches. One of the first immigrants that visit us.

With regard to this bird, "the song sparrow," whose nests are built in the immediate contiguity of dwellings, and near every thoroughfare, the following anecdote was told me by Mr. Hunter, the taxidermist to the Natural History Society: On one of his walks to the mountain, close to the footpath of the road leading in that direction, he discovered the nest of one of these birds, covered at the time with a dry leaf. Buildings were being erected in the neighbourhood. Next day on returning to the spot, he found that shavings occupied the place previously used by the leaf, which most carefully concealed the young ones. The colour of the shaving or chip was about that of the young birds at that period of their growth. On visiting next day the nest, the young birds escaped from it. In this instance the instinct of the bird exhibited itself in the employment of a material for the concealment of its nest, the least likely to attract observation from the fact of the erection of a building in the neighbourhood.

F. Canadensis. The Tree Sparrow.
F. arborea of Wilson.
Spizella monticola. Baird!

V.S.P. Upper mandible and tip of lower one black; the remainder with the legs and feet pale; irides deep hazel; eggs 5 pale brown mottled with dark brown.

Dorsal aspect. Crown bright chesnut, the feathers faintly tipped with whitish; nape of neck mixed chesnut and grey; back and scapulars blackish brown edged with pale brown; rump pale brown; smaller wing coverts grey tipped with white; great wing

coverts chesnut on the outer vanes, black on the inner and broadly tipped with white, causing an appearance of a couple of bars; primaries and secondaries brown, edged with white on the outer vanes of the former, and with pale brown on the outer vanes of the latter; tail square, brown, minutely edged with white on both outer and inner vanes.

Ventral aspect. A line from eye to nostrils white, changing above the eye to grey, which passing between the auriculars and chesnut crown, is lost over the sides of the neck; chin and upper part of throat, belly, vent, inner wing and tail coverts white; remainder of the throat and breast ashy grey; in the centre of the breast a black spot, most conspicuous when the feathers are a little removed.

1st and 6th subequal; 2nd and 4th equal; 3rd longest and very little longer than 2nd and 4th. Length $6\frac{1}{2}$ inches; alar breadth 9 inches; length of the tail $2\frac{3}{4}$ inches.

F. socialis. The Chipping Sparrow.

Spizella socialis. Wils.! Buon.! Baird!

V.S.P. Bill black; legs and feet pale flesh colour; irides deep hazel; eggs 4 to 5, greenish blue mottled with dark and light brown.

Dorsal aspect. Frontlet black; crown bright chesnut; back, scapulars and wing coverts black, broadly margined and tipped with brown; on the scapulars the brown partakes of a chesnut tinge; rump grey; primaries, secondaries and tail brown; the secondaries edged with chesnut brown on the outer vanes, and the primaries with white on the outer vanes; tail minutely edged with faint white.

Ventral aspect. Chin, throat, belly and vent white; breast, sides of neck and cheeks ashy grey; a line from the nostrils above the eye white; flank whitish grey.

2nd primary longest; 3rd next; 1st shorter than 4th but considerably longer than 5th. Length 5 inches; alar breadth $7\frac{1}{2}$ inches.

F. leucophrys. White-crowned Finch.

F. leucophrys of Wilson.

Zonotrichia leucophrys. Forster! Sw.! Baird!

V.S.P. Bill, legs and feet pale brown; irides hazel; eggs 4 to 5, chocolate or dusky colour.

Dorsal aspect. Crown of head white, bordered laterally, anteriorly and posteriorly by a broad black line; a line over the eye

white; nape of neck ashy grey; interscapular region with the scapulars pure brown tipped with greyish white; rump and tail coverts greyish brown; small wing coverts brown tipped with white; great wing coverts blackish brown margined broadly with chesnut on the outer vanes and tipped with white; primaries and tail cinnamon brown; outer vane of the lateral tail feathers pale; outer vanes of all the primaries edged with white, most conspicuous on the 2nd and 3rd; secondaries clove brown, broadly margined with chesnut on the outer vanes and tipped with white; tail square.

Ventral aspect. Chin and belly white; throat and breast ashy grey; flanks and tail coverts pale ochreous.

3rd primary longest; 2nd subequal to 3rd; 1st shorter than 5th. Length 8 inches; alar breadth 11 inches; length of tarsus and middle toe together 1 inch 10 lines.

F. graminea. Grass Finch.
F. graminea of Wilson!
Pooecetes gramineus. Gmel.! Baird!

V.S.P. Upper part of upper mandible brownish; lower one, legs and feet pale flesh colour; irides hazel; eggs 4 to 5, whitish mottled and blotched with reddish brown at their larger ends.

Dorsal aspect. Crown, neck, both scapulars, and rump clove brown, margined and tipped with dusky brown; smaller wing coverts bay on their outer vanes; primaries, secondaries and tail brown; the first edged with white on their outer vanes; the lateral tail feathers white except a brown streak on the inner vane; a white spot towards the tip of the second.

Ventral aspect. Chin, belly, vent, and tail coverts pure white; throat, cheeks, breast and flanks streaked with brown.

2nd primary longest; 1st and 3rd subequal, and very little shorter. Length $6\frac{3}{4}$ inches; alar breadth 10 inches; tail subfurcate.

F. tristis. American Goldfinch. (Chadronnée).
Carduelis Americana of Edwards.
Chrysometris tristis. Linn.! Bon.! Baird!

V.S.P. ET V. Bill brownish orange; legs and feet pale flesh colour; irides deep hazel; eggs 3 to 5, white, mottled at their larger ends with yellowish brown and subdued lavender purple.

Summer plumage. Dorsal aspect. Crown black; neck, dorsal region, rump and scapulars gamboge yellow; tail coverts and

smaller wing coverts white; shoulders black; greater wing coverts and secondaries jet black tipped with white; primaries wholly black; tail square, black, with a white spot at the extremity of each outer vane.

Ventral aspect. Tail and wing coverts white; all the other parts bright gamboge yellow.

Winter plumage. Dorsal aspect. Brownish olive; paler on the rump; greater wing coverts and secondaries tipped with brownish olive, which also supplies the white spots of the tail.

Ventral aspect. Chin yellow; breast and flanks pale brownish olive; belly and vent soiled white.

2nd primary longest; 1st and 3rd equal. Length 4½ inches; alar expanse 7½ inches.

F. pinus. Pine Finch.
Chrysometris pinus. Wils.! Bon.! Baird!

V.S.P. Bill brown; legs and feet purplish black; irides hazel; eggs unknown.

Dorsal aspect. Crown, neck, dorsal region, scapulars and rump clove brown, with broad light brown emarginations to the feathers, causing a dusky appearance; greater and smaller wing coverts clove brown edged and tipped with olive brown; primaries and secondaries blackish brown, the former edged with yellow on their outer vanes, the latter edged and tipped with olive brown, and a gamboge yellow spot on the outer vane near the quills, concealed by the greater wing coverts; tail subfurcate yellow at the quills, the remainder blackish brown.

Ventral aspect. Chin, breast, belly, flanks, and tail coverts clove brown, broadly edged and tipped with soiled white; vent soiled white.

2nd primary longest; 1st subequal to 2nd; and 3rd scarcely shorter than the 1st. Length 4¼ inches; alar breadth 7 inches.

F. linaria. Lesser Red Poll.
Linaria rubra minor. Ray!
Linaria minor. Ray!
Aegrothus linaria. Linn.! Baird!

V.S.P. Bill horn colour; legs and feet black; irides hazel; eggs 5, bluish white spotted with red.

Dorsal aspect. Crown shining lake colour; neck, back and scapulars dusky brown edged with flaxen; on the rump the tips are almost white; great and small wing coverts clove brown tip-

ped with white: wings and tail brown, minutely edged with white on the outer vanes of the primaries, and broadly on the outer vanes of the three last secondaries; tail subfurcate.

Ventral aspect. Chin brownish black; sides of throat, breast, and flanks like the back; belly and vent white. This description is taken from a female. In the male the "ventral aspect and crown are pale crimson approaching to white on the vent; crown deep crimson; frontlet and chin black."

2nd primary longest; 1st and 3rd equal. Length 5¼ inches; alar breadth 9 inches.

F. iliaca. Ferrugineous Finch.
Passerella iliaca. Baird!

V.S.P. Upper mandible brownish horn colour; lower one pale flesh with a black tip; legs and feet pale flesh colour; eggs 5, mountain green mottled with brown.

Dorsal aspect. Head, scapulars, and back dark greyish brown, brightening into ferruginous on the rump and wing coverts, the latter of which are tipped with ferruginous white; primaries and secondaries umber brown; the outer web of the 2 first primaries edged faintly with white; the outer webs of all the others, as well as the scondaries, with bright ferruginous; the 3 or 4 last secondaries broadly on outer webs of the tail feathers ferruginous, inner webs umber brown; tail coverts ferruginous.

Ventral aspect. Lower eyelid white; cheeks ferrugineous; chin, throat, breast and flanks white, with numerous triangular spots of bright ferruginous, most numerous on the breast; middle of the throat, belly, vent, tail and wing coverts white.

3rd primary longest; 2nd and 4th equal; 1st a little shorter than the 5th. Length 7 inches; alar breadth 9½ inches.

F. ludoviciana. Rose-breasted Grosbeak.
Guiraca (*Goniaphea*) *ludoviciana*. Linn.! Sw.! Baird!

V.S.P. Bill white horn colour; legs and feet bluish; irides hazel; eggs 4 to 5, white, spotted brown.

Dorsal aspect. Crown and nape of neck black; scapulars and dorsal region as far as the rump black, edged with olivaceous; rump and tail coverts white, some of the former tipped with brown; greater and smaller wing coverts blackish brown tipped with white; tail black; the three lateral feathers with a white spot occupying more than half the inner vanes.

Ventral aspect. Chin feathers black, minutely tipped with

lake ; throat, and upper part of the breast, and inner wing coverts rich lake ; the lake on the throat occasionally descending in a medial line on the breast ; flanks white with a few black spots ; belly, vent and tail coverts white.

The young bird and female are varied " with pale flaxen, dark olive, and whitish." In the female there is no lake on the breast or wings ; but the young male has a roseate tinge on the flaxen throat, and the lake wing linings as perfect as in the old male ; its upper mandible also is brownish.

2nd primary is longest ; 1st a little shorter than the 3rd, and of equal length with the 4th. Length 8 inches ; alar breadth 10½ inches.

F. purpurea. Purple Finch.

Carpodacus purpureus. Gm. ! Gray ! Baird !

V.S.P. Bill brownish horn colour ; legs and feet brownish white ; irides hazel ; eggs unknown.

Dorsal aspect. Shining lake colour ; most varied on the head, and neck, and rump ; the centre of the dorsal feathers being brownish black ; wings and tail dusky brown, edged on the outer vanes with lake ; greater and smaller wing coverts blackish brown edged with lake.

Ventral aspect. Chin, throat, breast, and sides of the belly, rich lake colour ; vent and tail coverts white, tinged rosaceous.

2nd primary longest ; 1st and 3rd subequal ; tail subfurcate. Length 6¼ inches ; alar expanse 8½ inches ; crest erectile at pleasure.

" Female and young varied with pale brown, and dusky without crimson ; beneath yellowish white, spotted with dusky brown."

Genus Pyrrhula.

Gen. char. Bill short, gibbous ; tip of upper mandible deflected over the lower ; nostrils basal, lateral, rounded, and usually concealed by the frontlet feathers ; tarsus shorter than the middle toe ; all of them free ; 4th primary longest ; tail subrotund or square ; tongue thick and fleshy.

P. enucleator. Pine Grosbeak.—Canadian Bulfinch.

Loxia enucleator of Wilson.

Pinicola Canadensis. Baird !

V. S. P. ET V. Bill, legs and feet brownish horn colour ; irides hazel ; eggs 4 or 5, white.

Dorsal aspect. Crown, nape of neck and rump, bright lake colour ; dorsal region and scapulars blackish brown, broadly

edged and tipped with lake; greater and smaller wing coverts black, broadly edged and tipped with white on the outer vanes; tail coverts blackish brown, tipped with lake colour; primaries, secondaries and tail, blackish brown; the primaries edged with lake colour, the secondaries with white on the outer vanes; the outer vanes of the tail feathers edged with brownish lake.

Ventral aspect. Chin, throat, breast, cheeks, and sides of the belly, lake colour, fainter than on the back; middle of the belly and vent feathers, dusky grey.

3rd primary longest; 2nd next; 1st shorter than the 4th. Length 9¼ inches; alar breadth 14 inches.

The young bird is wholly dusky beneath and on the back, the crown of the head and rump being olivaceous brown. The female possesses the same characteristics. The young bird of the second year has the inner parts and the rump with a lake tinge: which is also conspicuous on the ventral aspect.

Genus Icterus.

Gen. char. Bill longer than, or as long as the head, conical, unnotched, grooved internally,and slightly flattened towards the apex, compressed in the middle; nostrils basal, lateral; tarsus equal to or longer than the middle toe; 3rd and 4th primaries longest.

Icterus phœnicius. Red-winged Blackbird.
Sturnus prædatorius of Wilson.
Agelaius phœnicius. Baird!

V.S.P. Bill, legs and feet black; irides hazel; eggs 3 to 5 white, tinged with blue, streaked with purple and dark brown.

Whole dorsal and ventral aspects, including the primaries, secondaries and tail, shining jet black; small wing coverts and shoulders rich scarlet, except the lower row, which fades to orange.

3rd primary longest; 2nd and 4th equal; 1st and 5th equal. Length 4¼ inches; alar breadth 13 inches.

The female has the dorsal aspect black, with grey edgings to the feathers; the ventral aspect greyish white, streaked with black; the throat occasionally with a scarlet tinge. The young bird has the dorsal feathers edged with brownish; a white line over the eye; the smaller wing coverts brownish red; and the ventral feathers black edged with grey.

Sub genus Emberizoides.

Sub gen. char. In these the bill is short, conic, straight, not dilated at the base, and not so pointed as in the Fringilla tribe.

The genus bear a great resemblance to the finches, but differs from them in their habits.

I. agripennis. Rice Bunting.—Goglue.—Bob-o-link.
Emberiza oryzivora of Wilson.
Dolichonix oryzivorus. Baird !

V.S.P. ET V. Bill horn colour ; legs and feet pale flesh colour ; irides hazel ; eggs 5 to 6, dull white, inclining to olive, blotched with lilac and rufous brown towards the larger end.

Dorsal aspect. Front and crown of head black, the feathers sometimes tipped with rufous white ; back of head, and neck rufous white ; interscapular region black, the feathers edged with rufous white ; rump brown ; tail coverts brownish white ; scapulars white, edged with rufous white ; small wing coverts and great wing coverts black, the latter edged on the outer vanes with rufous white ; primaries, secondaries and tail brownish black, edged on the outer vanes and tipped with brownish white ; tail cuneiform, the feathers acuminate, the centre ones most so.

Ventral aspect. Black, the feathers tipped with rufous white, most conspicuous on the breast and belly ; cheeks and auriculars black.

2nd primary longest ; 1st next ; the others graduated. Length 6½ inches ; alar breadth 9½ inches.

The female and young male resemble one another, they are varied with brownish black and brownish yellow above, while a dull yellow prevails on their ventral aspects. The winter plumage of the male resembles that of the summer female, but on the whole yellower. This bird is the famous Butter Bird of the West Indies, which is there esteemed so great a delicacy. The tarsus and middle toe of this bird are equal in length.

I. pecoris. Cow Troopial or Cow Blackbird.
Emberiza pecoris of Wilson.
Molothrus pecoris. Baird !

V.S.P. Bill, legs and feet black ; irides white ; eggs 3 to 5, greenish white, spotted with olive brown.

Head, neck, and throat above and below, rusty brown, the rest of the dorsal and ventral aspects black, with a steel blue reflection ; wings and tail blackish brown.

1st primary longest ; the rest graduated ; tail square. Length 6 inches ; alar breadth 11 inches.

The female is wholly sooty brown. The young bird resembles the mother but has a spotted breast.

Genus Sturnus.

Gen. char. Bill conical but long, depressed, obtuse; base of upper mandible projecting on the forehead; nostrils broad, lateral, semi-closed by a membrane; tongue sharp, bifid; exterior and middle toes connected at base; 2nd and 3rd primaries longest.

S. Ludovicianus. Meadow Lark or Starling.

Alauda magna of Wilson!

Sturnella magna. Baird!

V.S.P. Upper mandible horn colour; lower one, with the basal and distal thirds horn colour, centre white; legs and feet pale flesh colour; eggs 4 to 5, white tinged with blue spotted with reddish brown.

Dorsal aspect. Three streaks of white separated by two of brownish black on the crown of head; neck, dorsal region, rump, tail and wing coverts, with scapulars brownish black, the feathers edged with chestnut, which is terminated by a white margin; primaries and secondaries brown, edged with brownish white on the outer vanes of the former, and barred and edged with the same colour on the outer vanes of the latter; tail rounded; 3 lateral tail feathers wholly white except towards the end of the outer vanes; 4th brownish black, with a white streak down the centre; the centre feathers brown, edged with whitish brown with imperfect bars; a streak from the orbit to nostrils gamboge yellow; behind the eye a black line terminating behind the auriculars which are grey; cheeks white.

Ventral aspect. Chin, throat, breast and belly, gamboge yellow, with a crescent of black on the chest, and a triangular spot of the same colour on each side of the throat; flanks white, spotted with black; vent dirty white; tail coverts brownish white with a black streak in the centre of each feather.

1st and 2nd primaries subequal; some of the secondaries elongated, nearly equal in length to the 3rd primary. Length 9¾ inches; alar breadth 14 inches. The young bird has the yellow fainter and the crescent of a duller black. This is a very rare bird in this district, but is occasionally met with.

Genus Corvus.

Gen. char. Bill thick, compressed at the sides, stout, and bent towards the apex; nostrils basal, open, and concealed by the projecting bushy feathers of the frontlet; toes like the other genera of this family, but free; middle toe shorter than the tarsus; 3rd and 4th primaries longest; wings long and acuminate.

C. corax. The Raven.
• *C. carnivorus.* Baird !

D.C. Bill, legs and feet black ; irides with two circles, greyish white and cinereous brown; eggs 5 to 6, muddy bluish green, spotted with olive brown.

Dorsal and ventral aspects, glossy black with steel blue reflections; tail much rounded extending beyond the wings; 3rd primary longest. Length about 26 inches. A rare bird in the district of Montreal, though occasionally met with.

C. corone. The Common Crow.
C. Americanus. Baird !

V.S.P. Bill, legs and feet black; irides hazel ; eggs 2 white.

Dorsal and ventral aspects. Glossy black, with purple reflections on the back, and sombre on the vent. Tail rounded a little, extending but little beyond the wings. The feathers acute. 1st primary very short; in length equal to 9th. 4th primary longest. Length 18½ inches. Very common, often hybernating with us.

Subgenus Garrulus.

Sub. char. Bill shorter and straighter than with the crows. Upper mandible somewhat inflected at tip; lower one keeled; tail more or less cuneiform ; feathers of head erectile.

C. cristatus. Blue Jay.
Cyanura cristata. Baird !

V.S.P. Bill and legs with the feet black ; irides hazel ; eggs 5, dull olive, spotted brown.

Dorsal aspect. Frontlet, and line rising perpendicularly from the nostrils, black ; streak from the eye passing above the auriculars and uniting on the nape of the neck jet black ; crest, small wing and tail coverts sky blue ; dorsal region sky blue tinged with purple ; tail long, subrotund, sky blue, with 10 or 12 bars of black on the centre feathers, the bars diminishing in number to the lateral feathers, on which they are obsolete, or at least imperfect; all the feathers except the centre ones broadly tipped with white; greater wing coverts sky blue, barred black and tipped with white; primaries brownish black on the inner vanes, and sky blue on the outer ; secondaries, except the three or four last which are marked on both vanes, like the great wing coverts, the others brownish black on the inner vanes, and sky blue barred with black on the outer.

Ventral aspect. A semicircular spot over the eye, chin, throat and auriculars bluish white tinged with blue, darkest on the throat at the mesial line; a crescentic spot on the breast, ascending upwards and terminating behind the auriculars; belly and vent grey, lighter on the vent; wing coverts blue; tail coverts white.

5th primary longest; 6th next; 4th and 7th subequal; 2nd and 9th equal; 1st considerably shorter than the secondaries. Length 11¼ inches; alar expanse 16 inches; length of tail 5¾ inches; length of bill 1 inch 1 line. A very elegant bird. The whole dorsal aspect being very glossy.

C. Canadensis. Canada Jay.

Perisoreus Canadensis. Baird!

V.S.P. Bill, legs and feet black; irides hazel; eggs 3 to 4, lilac.

Dorsal aspect. Frontlet, and front half of the crown dirty white, changing to blackish brown on the hind part of the crown and nape of the neck; back, rump, scapulars and wing coverts, slate grey; primaries and secondaries blackish brown tipped with dirty white, and edged with slate colour on the outer vanes; tail cuneiform, slate grey, approaching lead colour, tipped with soiled white.

Ventral aspect. Auriculars, sides of the throat, chin and throat soiled white, the shafts prolonged in a filiform state beyond the vanes and black, causing a hairy appearance beyond the feathers. This also occurs in the C. cristatus. Breast, belly, wing and tail coverts brownish grey.

5th primary longest; 4th and 6th equal; 3rd a line shorter than the 7th; 2nd shorter than the 8th; 1st shorter than the secondaries. Length 11 inches; alar breadth 16 inches.

Fam. IV. Tenuirostres.

Genus Sitta.

Gen. char. Bill straight, attenuate, awl-shaped and acuminate; upper and lower mandibles recurved from the centre; nostrils basal, lateral, rounded, and concealed by nuchal bristles; tongue horny; feet robust, 3 toes before and 1 behind, exterior connected to the middle at its base; hind toe long with a strong hooked nail; tail of twelve feathers of moderate length, short in some species; 2nd, 3rd and 4th primaries longest.

S. Carolinensis. White-bellied Nuthatch.

S. Carolinensis. Baird!

V.S.P. Upper mandible, and distal half of the lower, black;

basal half of the lower, white; legs and feet pale flesh colour; irides hazel; eggs 5, dull white spotted with brown.

Dorsal aspect. Crown and nape of neck jet black; dorsal region to the rump lead colour; greater and smaller wing coverts black, edged and tipped on their outer vanes with lead colour; primaries and secondaries blackish brown, edged with lead colour on the outer vanes of all, except the three first primaries, the 1st of which is unmarked in any way, and the two next with a white edging about the centre of their outer vanes; tail square, the two centre feathers lead colour, the others blackish brown, with a broad white spot; the outer vane of the lateral feather wholly white.

Ventral aspect. A line from nostrils over the eye, cheeks, sides of neck, (and here bounded by a black line,) chin, throat, breast, belly, and tail coverts white, vent feathers tinged with rusty colour.

2nd primary longest; 3rd next; 4th next; and 1st shorter than 5th. Length $5\frac{1}{2}$ inches; alar expanse $9\frac{1}{2}$ inches. The young bird is stated to have a lead coloured head.

S. Canadensis. Red-bellied Nuthatch.

S. Canadensis. Baird!

V.S.P. Bill black, with the exception of the basal half of the lower mandible; legs and feet dusky, greenish yellow; eggs unknown.

Dorsal aspect. Crown and nape of neck jet black; a white line from the nostrils passes over the eye above the auriculars and is lost upon the shoulders; this is succeeded by a black line from the angle of the mouth and ending in the same place; auriculars white; dorsal region, rump, scapulars, and wing coverts lead colour; primaries and secondaries pale brown, faintly margined on their outer vanes with lead colour; tail short, square; two central feathers lead colour, the others blackish brown, with a white spot like a bar commencing about the centre of the lateral feathers, and terminating at the tip of the 4th.

Ventral aspect. Chin white; throat, breast, and belly, with vent feathers, rusty coloured.

2nd primary longest; 1st and 4th equal. Length $4\frac{1}{2}$ inches; alar breadth $7\frac{1}{2}$ inches. The young bird with a plumbeous heads

Genus Certhia.

Gen. char. Bill more or less long, with a greater or less curvature, triangular, compressed, slender and acuminate; nostril

basal, naked, horizontally perforated in a membrane and half closed by a membrane; feet slender; inner toe free; outer toe connected at base to inner one; claws considerably curved, that of the hind toe longest; tail graduated, elastic and acuminate; 3rd and 4th primaries longest.

C. familiaris. Brown Creeper.
C. Americana. Baird!

V.S.P. Upper mandible dark; lower one pale flesh colour; legs and feet dusky; eggs 7 or more, cinereous, spotted with reddish yellow and streaked with dark brown.

Dorsal aspect. Prevailing tint ferruginous, darkest on the head, mixed with white on the interscapular region, scapulars, and wing coverts, and pure ferruginous on the rump; tail cuneiform, drab colour, the feathers acuminate; wings rounded, pale brown, with a single white bar across their middle tinged with ferruginous, and margined faintly with brownish white on the outer vanes.

Ventral aspect. French white; the feathers of the whole body exceedingly silky and long.

3rd primary longest; 2nd shorter than 4th. Length 5 inches; alar expanse 7 inches. Tail about two lines longer than the body.

Genus Trochilus.

Gen. char. Bill long, straight or more or less arcuate, slender, the base depressed, and as wide as the forehead, point acuminate; nostrils linear, basal, covered by a membrane; tongue, long, extensible, bifid and tubular; legs very short; tarsus shorter than middle toe, more or less feathered; front toes nearly free; wings acute; 1st primary longest.

T. colubris. Ruby-throated Humming Bird.
T. colubris. Baird!

V.S.P. Bill, legs and feet dusky black; irides deep hazel or black; eggs 2, white.

Dorsal aspect. Except the wings and tail rich golden green, darkest on the head; wings and tail brownish black; the former falciform, the latter furcate.

Ventral aspect. Chin, throat and cheeks rich ruby colour, the feathers somewhat erectile; shoulders, breast, belly, and coverts pale brown, in the first mentioned situation, tinged with golden green; vent white.

1st primary longest; the others graduated. Length $3\frac{1}{8}$ inches; alar expanse 4 inches. The female has a similar dorsal aspect to the male, but less brilliant; her ventral aspect is white, the feathers faintly edged and tipped with rufous, and the three lateral tail feathers tipped with white. In the young bird the throat strongly inclines to yellow. In the adult males which I have seen, I have not detected "the three outer tail feathers rusty white at the tips," as according to Nuttal.

2nd division of Passerinæ, in which the external and middle toes are united to their penultimate articulation.

Fam. Syndactyla.

Genus Alcedo.

Gen. char. Bill quadrangular, long and straight, edged, acuminate; nostrils basal, lateral, oblique, almost wholly closed by a naked membrane; legs short, naked above the knee for a considerable space; tongue short and fleshy; outer toe connected to the middle as far as the second joint, and the inner to the middle as far as the first joint. 3rd primary longest.

A. alcyon. Belted Kingfisher.
Ceryle (Megacerile) alcyon. Baird!

V.S.P. Bill black, pale at the tip; legs and feet bluish; claws black; irides hazel; eggs 6, white.

Dorsal aspect. A white spot between the orbit and nostrils; crest, nape of neck, interscapulary region, scapulars, small and greater wing coverts, (which are also faintly tipped with white,) and rump, bluish slate colour; primaries and secondaries black; the former with half of their inner vanes white, and barred with white on the collateral portion of the outer vane; the four or five last ones edged on the outer vane with bluish slate colour and tipped with white; secondaries bluish slate on the outer vanes; black barred with white on their inner vanes, tipped with white except the 4 or 5 last ones which are wholly bluish slate colour; tail square; the two centre feathers bluish slate, with a black streak down their shafts, the others all black, with 11 or 12 narrow bars of white, with a terminal tip of the same colour, and edged with slate blue on the outer vanes.

Ventral aspect. Chin, throat, and sides of neck, belly, vent, wing and tail coverts white; breast with a slate blue belt reaching from shoulder to shoulder.

3rd primary longest; 2nd next; 1st about a line shorter than the 4th. Length 13½ inches; alar expanse 19½ inches. Length of bill from angle of mouth 2 inches and two thirds. The female has the sides and a belt on the breast ferruginous, and the slate blue duller.

Ord. III. Scansoria.

Genus Picus.

Gen. char. Bill more or less long, straight, and cuneiform at the tip; nostrils basal, open, covered by bristly feathers; tongue round, extensile, sharp and rigid at the point, and armed with stiff reversed bristles; two toes before and generally two behind; feet robust; anterior toes connected at their base; posterior ones divided; 3rd and 4th primaries longest; two lateral tail feathers very short; the shafts of all the tail feathers mucronate, strong, and very rigid.

1st Section.—Tetradactyla.

Subdivision 1. *With the bill curved, cuneiform, under mandible not carinate.*

P. auratus. Golden-winged Woodpecker.
Colaptes auratus. Baird!

v.s.p. Bill dusky horn colour; legs and feet pale bluish; irides hazel; eggs 6, white.

Dorsal aspect. Crown of head cinereous brown tinged with olivaceous; posterior part of the crown with scarlet crescentic streak; nape of neck, interscapular region, scapulars, greater and smaller wing coverts, and outer vanes of the secondaries, umber coloured barred with black; rump white; tail coverts white barred with black; outer and inner vanes of the primaries, and inner vanes of the secondaries black, with rudimentary white bars on the outer vanes of the 3rd and upwards; tail cuneiform, the feathers acuminate black; the outer vane of the lateral ones barred with white, the bars rudimentary on the outer vanes of the second; the shafts of the quills of the wings and tail golden yellow.

Ventral aspect. Cheeks, and around the eye, auriculars, chin, and throat, cinnamon colour approaching to fawn, deepening into cinereous on the sides of the neck; moustaches and crescent on the breast jet black; belly, vent, and sides of flanks with round black spots on a white ground in the two former situations, and on a cinnamon ground in the two latter; tail coverts white with black

bars; wing coverts yellow; inner surface of wing and tail tinged with golden yellow, changing to black towards the tips and edges of the feathers; the spots on the belly and vent are orbicular, those of the flanks and sides cordiform approaching to reniform.

1st primary very short; 2nd shorter than the 8th; 4th and 6th equal; 5th longest. Length 11½ inches; alar breadth 16½ inches. The young bird is dull grey, and wants the red and black crescents. The female wants the black moustaches, but has the other two distinctive marks. A most elegant bird.

Subdivision 2. *With the bill straight, and carinate above and below.*

P. erythrocephalus. Red-headed Woodpecker.
Melanerpes erythrocephalus. Baird!

V.S.P. Bill white at the base, bluish towards the end; legs and feet bluish; irides hazel; eggs 6, white spotted with red.

Dorsal aspect. Head and neck crimson; dorsal region including the scapulars and wing coverts jet black; primaries and tail black, the three lateral feathers of the latter with white tips; secondaries and rump white.

Ventral aspect. Chin, cheeks, sides of neck, and breast crimson like the head; belly, flanks, vents and tail coverts white.

3rd primary longest; 2nd next; 1st next. Length 9 inches; alar expanse 15½ inches.

P. varius. Yellow-bellied Woodpecker.
Sphyrapicus varius. Baird!

V.S.P. Bill black; legs and feet bluish; irides hazel; eggs 4, white.

Dorsal aspect. Crown of the head crimson, bordered posteriorly by a crescent of black; nape of neck yellowish white; interscapular region and rump varied with white, yellowish white, and black spots and bars; scapulars and small wing coverts black; a few of the greater wing coverts white; tail coverts with their outer vanes black, their inner ones white; primaries and secondaries black, tipped and barred with white; tail cuneiform; the two lateral feathers edged with white on the outer vanes, and tipped with the same colour; a streak of white along the inner vanes of the central feathers with two or three black spots.

Ventral aspect. A yellowish white line over the eye terminating on the nape of the neck; from behind the eye a black line including and terminating behind the auriculars; from the nos-

trils a yellowish white streak passes below the eye and terminates on the shoulders; from the angle of the mouth a black streak passes down on each side of the throat and terminates on the black orbicular spot which invests the breast; the black streak on either side invests the crimson chin and throat; the black breast is bounded by a gamboge yellow streak which commences on the shoulders, meets at the lower part of the breast, and is thence continued in the mesial line to the belly and vent; sides of the breast, and flanks yellowish brown streaked with black; inner wing and tail coverts whitish yellow.

2nd and 3rd primaries subequal and longest; 1st considerably shorter than the 4th. Length $8\frac{1}{3}$ inches; alar expanse 13 inches.

P. villosus. Hairy Woodpecker.

P. (Trichopicus) villosus. Baird!

V.S.P. Bill, legs and feet bluish horn colour; irides hazel; eggs 5, white.

Dorsal aspect. Frontlet feathers brownish white; crown black, bordered posteriorly by a crimson crescent; line from the nostrils over the eye white, terminating at the crimson crescent; line from the eye passes backwards, including the auriculars, and meeting its fellow on the nape of the neck, forms a black border to the crimson; white sides of the neck separated in two portions by a black streak commencing below the angle of the mouth and terminating on the shoulders; nape of neck black; interscapular region and rump black, with a white irregular streak down the centre: scapulars black; greater and smaller wing coverts black, with a white spot near the tips of the outer vanes; the two lateral tail feathers white; the third black with a dirty white tip; the others all jet black with shining shafts; primaries and secondaries black barred with white.

Ventral aspect. White, soiled towards the vent.

3rd and 4th primaries subequal and longest; 2nd and 5th subequal; 1st shorter than the 6th. Length $9\frac{1}{4}$ inches; alar expanse 14 inches. The occipital band in the female is black.

(*To be continued.*)

CORRESPONDENCE.

AN ENTOMOLOGICAL GRAVE-DIGGER.

To the Editor of the "Canadian Naturalist."

SIR,—As I was sitting this morning on the lower step of my veranda, my gaze fixed listlessly, during the noontide heat, upon the gravel-walk before me; "thinking," I verily believe, "of nothing," or at most, entertaining a dreamy impression that I was becoming a focus for the concentration of the sun's rays—my eyes were suddenly attracted to an insect whose motions very soon riveted my attention.

I at once perceived that it belonged to the order *Hymenoptera*, but even now that I have the specimen in question before me, I am afraid to name its *genus*: it is, however, similar to the *Tenthredo scrophularia*, if it is not actually that insect. The accompanying sketch may enable you to arrive at a decision on this point: it is the natural size, the length being exactly five lines.

The little creature, when I first caught sight of it, had already commenced, within four feet of the spot on which I was seated, its work of excavation; for as I looked it disappeared, and shortly afterward returned to the surface of the ground tail first; and running backward over a tiny mound it had previously made, deposited a grain of gravel fully as large as its own head *outside* the mound, with the evident intention that it should not roll back again into the cave it was in process of forming. This operation was continued with great rapidity; and ever as it re-entered the orifice I saw minute particles of sand fly upward, impelled purposely by its descending feet.

The care with which the insect distinguished between the larger and the smaller grains was wonderful; those only whose gravity might have caused them to roll down again, had they been placed below the apex of the mound on the side on which the work was carrying on, were conveyed *beyond* the mound; the smaller grains were added to the mound itself without much apparent discrimination.

After a time the work was evidently completed to the satisfaction of the laborer, for it flew away to the grass-edging of a flower-border distant about six feet from the cave, and immediately emerged from thence, dragging after it, for it was running back-

ward, the body of a large spider not long dead,—a spider whose bulk was at least three times as great as that of its intending sexton. On arriving within twelve inches of the sepulchre the insect left the corpse, and hastened thither to ascertain, as I cannot doubt, whether or not the orifice was large enough for its admission: it was not so, and the grave-digger resumed his work enlarging, though but very slightly, showing thus how true his eye was, the opening he had made. Returning to the spider he dragged it onward, and, still running backward, pulled it after him within the hole; and I noticed that so nice had been the calculation, there was exactly sufficient space for the passage of the body—sufficient, but not a hair's-breadth to spare.

The insect soon once more emerged, and immediately commenced filling in the grave, a work he speedily though carefully accomplished. And when that work was completed, he ran round and round with great celerity upon the surface, scattering the gravel in all directions with his feet, with the undoubted object of obliterating every, the faintest mark by which his *cache* might be discovered: and *so* effectually was this portion of his operation executed, that half an hour subsequently I was unable, though I searched diligently and anxiously, assisted too by eyes far keener than my own, eyes that had also watched the whole transaction, to find it out myself.

Meantime, having sent for my net, I, not without some feelings of compunction, captured the little workman, and putting him to death by the shortest possible method, made a sketch of him for future reference.

Now, what was the object of the little creature in conveying beyond the ken of other insects the booty it had discovered? My first impression was that it was an *Ichneumon*, and that it was about to deposit its eggs within the body of the spider; but *Ichneumons*, I believe, invariably make use of living caterpillars for that purpose; and after having effected my capture, I could discover no trace of an *ovipositor*. I imagine, therefore, that it must have intended to make a meal, or many meals off the carcase: but why it should have expended so large an amount of time, and given itself so much trouble on that account, I confess I am unable to determine.

A reflection, and I conclude. How slender is the line of demarcation separating instinct from reason! and how marvellous the Creative Power that could have imparted to an insect so in-

significant, faculties such as I have attempted, however feebly, to describe!

I have the honour to be, Sir,

Your most obedient servant,

VINCENT CLEMENTI, B. A., Cantab.

Peterboro', C. W.,
26th July, 1862.

NOTE.—The insect referred to by our correspondent was probably one of the fossorial wasps or Sand-wasps, some species of which have precisely the habit described. Their object is to provide foot for their young; their eggs being deposited with the spiders or caterpillars which they bury, and the larvæ subsisting on the provision thus made for them. Were the specimen sent to us, no doubt the species might be determined. EDS.

MISCELLANEOUS.

Occurrence of the Blue Grosbeak (Guiraca cœrulea, Swainson) at Mille Vaches, Lower St. Lawrence.

Canadian Ornithologists will be gratified to learn that the beautiful Blue Grosbeak is now for the first time added to the list of birds visiting Canada:—On the 7th of May both sexes of the species were noticed by Mr. Peverley, sen., of Mille Vaches; they were accompanied on the same tree by the little Indigo bird. Mr. Peverley is continually residing in the vicinity of the primitive forests, where he has good opportunities of observing our feathery visitors, and the unusual occurrence of a bird having such brilliant blue colour at once attracted his attention; he therefore lost no time in securing the male which is stuffed and in his possession. The *habitat* of the Blue Grosbeak is the "more Southern States from the Atlantic to Pacific, south to Mexico." Judging from the season, together with the fact of the female having been noticed, there is good evidence that they intended to build in this country.

Occurrence of the Stone Chat (Saxicola œnanthe, Bechst.) at Beauport, near Quebec.

A single specimen of this pretty bird was procured and stuffed by me; it is now in the Museum of the Smithsonian Institution, Washington. It also forms an addition to Canadian Ornithology.

Occurrence of the Yellow Rail (Porzana noveboracensis) in the vicinity of Quebec.

Although this handsome little bird is mentionned by Swainson in the "Fauna Boreali Americana" on the authority of Mr. Hutchins who resided on the coast of Hudson's Bay, near the efflux of Severn River, I am not aware that it has appeared in any of the published lists of Canadian birds. It is extremely rare in this latitude, only two specimens have been procured during two years; both were shot by Mr. G. Campbell of the Quebec Customs; one is in his possession, and the other he presented to me, which I stuffed, and is now in the collection of S. Derbishire, Esq.

WM. COUPER, Quebec.

(From proceedings of the Geological Society of London.)

On the Geology of the Gold-fields of Nova Scotia. By the Rev. David Honeyman. (Communicated by the President.)

The author, at the request of the Provincial Government Commission for the International Exhibition, made some observations on the auriferous rocks at Allen's and Laidlow's farms, near the junction of the Halifax and Windsor and the Halifax and Truro railways. He found chloritic schist, with vertical auriferous quartz-veins, and a gold-bearing horizontal quartz-vein (the "barrels" of the miners) lying on the schist and overlaid by quartzite and gravel. By the neighbouring railway sections the chlorite-schist is seen to alternate in broad bands with quartzite, and to be associated with granite. The author thinks there is reason to believe that the quartzite may be of Lower Silurian age.

"On some Fossil Crustacea from the Coal-measures and Devonian Rocks of New Brunswick, Nova Scotia, and Cape Breton." By J. W. Salter, Esq., F.G.S., of the Geol. Surv. Great Britain. One of the Devonian fossils is apparently allied to the Stomapods, and is named *Amphipeltis paradoxus* by Mr. Salter; it was obtained by Mr. Hartt and Dr. Dawson near St. John's, where it occurred with plant-remains; another Crustacean fossil from the same locality collected by Mr. Payne, is a new *Eurypterus*, *E. pulicaris.* Other remains of *Eurypteri* have been sent also by Dr. Dawson, from the coal-measures of Port Hood and the Joggins; and with these a new Amphipod, *Diplostylus*, having some characters of alliance with *Typhis* and *Brachyocelus.*

MONTHLY METEOROLOGICAL REGISTER, ST. MARTINS, ISLE JESUS, CANADA EAST, (NINE MILES WEST OF MONTREAL,) FOR THE MONTH OF JUNE, 1862.

Latitude, 45 degrees 32 minutes North. Longitude, 73 degrees 36 minutes West. Height above the level of the Sea, 118 feet.

BY CHARLES SMALLWOOD, M.D., LL.D.

Day of Month.	Barometer—corrected and reduced to 32° F. (English inches.)			Temperature of the Air.—F.			Tension of Aqueous Vapour.			Humidity of the Atmosphere.			Direction of Wind.			Horizontal Movement in 24 hours. In miles.	OZONE. Mean amount of, in tenths.	RAIN. Amount of, in inches.	SNOW. Amount of, in inches.	WEATHER, CLOUDS, REMARKS, &c. &c. [A cloudy sky is represented by 10, a cloudless one by 0.]		
	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.					8 a. m.	2 p. m.	10 p. m.
1	29.682	29.589	29.589	50.1	83.2	60.5	.277	.846	.367	.75	.75	.71	S.	S. S. W.	S. S. E.	17.80	1.5			Clear.	C. C. Str. 4.	Clear.
2	608	516	608	44.0	83.6	65.0	.218	.884	.488	.76	.77	.75	S. S. E.	S. S. W.	S. S. E.	0 00	1.5			Cu. Str. 10.	Hazy.	Hazy.
3	664	810	930	58.4	76.0	62.1	.372	.551	.406	.78	.75	.74	N. N. E.	N. E.	S. by W.	3.90	1.5			Clear.	C. C. Str. 8.	C. Cum. 6.
4	974	30.085	980	56.0	72.2	55.7	.265	.273	.295	.75	.95	.68	N. E by E.	S S. E.	S.	16.11	1.0			Cirr. Str. 4.	C. C. Str. 4. Im.S.H.	C. C. Str. 8.
5	982	28.855	855	58.0	85.8	66.0	.365	.450	.383	.76	.37	.61	S. S. W.	S. W.	S. W. by S.	15.00	2.0			Clear.	Clear.	Hazy.
6	777	723	746	52.2	84.2	56.2	.282	.584	.363	.73	.50	.81	N. E by E.	S. E. by E.	N. E. by E.	24.16	1.5			Hazy.	Hazy	Cirr. 2. Lunar Corona.
7	603	714	796	44.6	62.4	53.4	.189	.319	.269	.64	.58	.67	N. E. by E.	N. E. by E.	N. E. by E.	125.26	1 5	Inapp.		Cu. Str. 10.	Clear. Slight Shower.	C. C. Str 4.
8	862	898	954	52.5	72.1	55.0	.232	.303	.269	.60	.39	.62	N. E. by E.	N. E. by E.	S.	158.00	1 5			Cirr. 2.	Cirr. 2.	Clear.
9	891	864	861	56.1	77.8	65.6	.269	.285	.409	.62	.30	.79	S. S. W.	W.	W. S. W.	212.46	2.0			Clear. Light frost.	Clear.	Hazy.
10	872	796	765	58.4	83.5	67.8	.358	.552	.400	.73	.48	.61	S. W.	S. W.	S. W.	79.00	2.0			Hazy.	Hazy.	"
11	574	497	465	56.1	93.1	70.1	.262	.800	.557	.58	.52	.77	S. W.	S. W.	S. W.	14.00	2 0			Clear.	"	"
12	347	307	445	57.4	82.5	65.0	.295	.578	.549	.63	.54	.89	W. by S.	W.	N. E.	226.80	2.5	0.553		Clear.	"	Clear. Eclipse of the Moon.
13	593	616	685	62.7	82.1	65.0	.485	.578	.540	.86	.54	.89	N. W.	S. by W.	W. S. W.	97.10	1.5			"	C. Cirr. 4. So. Ha.	"
14	673	714	727	50.0	64.7	55.8	.309	.396	.355	.85	.65	.84	N. E. by E.	N. E. by E.	N. W. by W.	70.00	1.5			"	Cu. Str. 4.	C. Cirr. 2.
15	733	872	983	42.2	53.2	40.1	.222	.219	.203	.83	.54	.82	N. N. W.	N.	W. S. W.	188.40	1.5			"	Cirr. Cum. 4.	Clear.
16	30.144	30.070	30.036	44.6	71.1	46.1	.211	.316	.238	.72	.42	.77	S. W.	W. S. W.	S. S. W.	90.30	1.5			" Slight frost.	Clear.	"
17	29.935	29.714	29.520	52.1	84.0	71.0	.302	.590	.476	.82	.51	.64	S. S. W.	S. S. W.	S. S. W.	157.74	1.5			Cu. Cirr. 4.	C. Cirr. 4.	Cu. Str. 4. Distant Lightning.
18	341	324	344	61.5	77.0	60.1	.406	.639	.462	.74	.69	.91	S. W.	S. S. W.	N. N. E.	225 80	3.0	0.104		C. C. Str. 4.	C. C. Str. 10.	Rain.
19	482	483	587	51.1	64.4	56.0	.321	.403	.398	.86	.67	.90	N. N. E.	N. N. E.	S. by E.	152.90	3.0	0.104		Cu. Str. 8.	C. Cu. 4.	C. C. 8.
20	657	534	762	52.0	77.2	57.3	.334	.678	.416	.86	.73	.88	S. S. W.	S. W.	S. by W.	58.70	2.5	0.042		C. Cu. 4.	" 2.	C. C. Str. 10.
21	730	700	792	47.2	76.7	56.2	.280	.616	.398	.88	.71	.90	S. E.	W.	W.	115.66	3.0	Inapp.		Rain.	Cu. Str. 4.	C. Str. 4. Dist. Thunder.
22	891	895	876	52.2	71.9	56.7	.334	.493	.357	.86	.54	.78	W.	W. S. W.	W. S. W.	290.79	2 5			Clear.	C. C. 4.	" 2.
23	928	849	879	51.1	86.2	56.7	.256	.762	.342	.71	.62	.78	W. S. W.	S. S. W.	S. S. W.	88.30	2.0			"	Clear.	Clear.
24	812	884	806	47.2	69.2	60.3	.249	.529	.456	.77	.75	.88	N. E. by E.	W. S. W.	N. E. by E.	30.80	2 0	Inapp.		C. C. Str. 6.	Slight Shower.	Cu. Str. 10.
25	778	845	834	56.1	77.5	67.0	.391	.632	.438	.87	.67	.68	N. E. by E.	N. E. by E.	S. S. E.	24 80	1.5			Clear.	Cu. Str. 2.	Clear.
26	750	720	700	60.1	89.8	68.2	.374	.802	.519	.73	.57	.75	N. by E.	S. S. E.	S. E.	42.90	1.5			C. Cirr. 4.	C. Cu. 4.	C. C. 2. Dist. Light. & Th.
27	665	572	634	64.6	96.0	76.1	.427	.633	.652	.71	.38	.73	S. by W.	S. W.	S.	61.10	2.0			Clear.	Clear.	Cu. Str. 4.
28	687	654	667	66.0	96.1	77.6	.476	.626	.564	.75	.37	.61	W. S. W.	S. S. E.	S. E. by E.	20.80	1.0			C. C. Str. 6.	Cu. Str. 4.	" 2.
29	666	598	572	62.4	89.9	70.7	.370	.630	.462	.66	.45	.65	S. S. E.	E.	W.	56.80	2.0			Clear.	Cirr. 4.	" 10.
30	416	322	480	60.5	76.2	53.0	.458	.652	.348	.88	.73	.86	S. E.	S. E. by E.	W. S. W.	191.70	2.5	0 329		Cu. Str. 10.	C. C. 10.	" 4.

REPORT FOR THE MONTH OF JULY, 1862.

Day of Month.	Barometer—corrected and reduced to 32° F. (English inches.)			Temperature of the Air.—F.			Tension of Aqueous Vapour.			Humidity of the Atmosphere.			Direction of Wind.			Horizontal Movement in 24 hours. In miles.	OZONE. Mean amount of	RAIN. Amount of, in inches.	SNOW. Amount of, in inches.	WEATHER, CLOUDS, REMARKS, &c., &c. [A cloudy sky is represented by 10, a cloudless one by 0.]		
	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a.m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.					6 a. m.	2. p. m.	10 p. m.
1	29.517	29.495	29.509	50.0	67.8	60.0	.309	.418	.365	.85	.62	.76	W. S. W.	W. S. W.	S W.	193.10	2.0			Cu. Str. 4.	Clear.	Cu. Str. 4.
2	671	743	854	60.1	84 2	62.9	.374	.584	.429	.73	.50	.77	S. S. W.	S. W.	S. by E.	82.80	1.5			C. C. Str. 4.	"	C. Cirr. 4.
3	905	883	30.030	54.7	84.2	63.0	.282	.677	.429	.67	.60	.77	S. E.	S. S. W.	S. S. E.	25.40	1.6			Clear.	Cirr. 2.	C. Str. 4. Dt. T. & Lt. 8 p.m.
4	30.062	943	29.933	56.4	89.8	73.1	.308	.848	.624	.69	.61	.79	S. by W.	S. W.	S by W.	197.10	1.0			"	Cu. Str. 4.	C. C. Str. 4.
5	29.853	814	762	70.0	93 5	74.2	.592	.887	.641	83	.56	.77	W. S. W.	S. W.	S. W.	103.20	1.5	0.050		"	Rain. Dist. Thunder.	C. Str. 5.
6	642	588	623	70.6	94.0	73.9	.592	.840	.552	.83	.65	.70	W. S. W.	W. S. W.	S S. W.	285.50	1.0			Hazy.	Hazy.	Hazy.
7	754	600	468	63.3	84.3	71.0	.416	.704	.476	.72	.60	.64	S.	W. S. W.	S. by W.	55.60	1.0			"	"	"
8	451	472	547	65.0	85.4	54.7	.576	.657	.276	.92	.55	.65	S. by W.	S. W.	S. W.	86 40	1.0	Inapp.		Slight Rain.	Clear.	C. C. Str. 8.
9	414	397	642	47.4	61.4	45.4	.249	.442	.245	.77	.83	.81	S. W.	S. S. W.	S. W.	114.40	2.5	0.206		Cu. Str. 10.	Rain.	Cu. Str. 4.
10	702	735	759	49 5	70.6	54.7	.273	.616	.315	.80	.57	.78	W. S. W.	W. by S.	W. by S.	103.80	1 5			Clear.	Clear.	Clear.
11	809	765	801	52 1	79.8	66.2	.257	.606	.438	.66	.69	.68	W. S. W.	W. S. W.	W. by S.	182.60	1 0			Hazy.	Hazy.	Hazy.
12	738	555	550	58 9	72.6	65 4	.358	.489	.451	.73	.62	.73	W.	S. W.	S.	211.90	1 0			"	"	"
13	496	344	479	64 2	82.2	75.2	.464	.572	.897	.77	.52	.71	S. W.	W. S. W.	S. S. W.	149 50	2 0	0 300		Cu. Str. 10.	C. Cirr. 8.	Cu. Str. 4.
14	606	644	760	50 0	73 6	60 5	.240	.545	.403	.68	.67	.79	N. E. by E.	S by E.	S. W.	86.10	1 0			" 6.	" 8.	Clear.
15	722	701	611	49.4	86.0	62.4	.272	.684	.517	.73	.56	.91	S. W.	S. S. W.	N. E. by E.	83.60	2 5	0 533		Clear Heavy dew.	" 4.	Nimb. 10.
16	606	604	742	60.1	79.2	60.2	.439	.612	.396	.88	.62	.76	S. by W.	S. E.	W.	235.40	2 0			"	" 8.	Clear. Distant Thun. & Lightning.
17	806	785	929	58.6	69 0	62.8	.365	.501	.413	.70	.72	.77	N. E. by E.	N. E. by E.	S. by W.	123.00	1 0			Cu. Str. 10.	Cirr. 4.	"
18	950	956	947	54.1	85.0	64.2	.315	.739	.433	.77	.62	.73	N. E. by E.	S. by W.	S. by W.	28.10	1 5			Clear.	Clear.	Str. 2.
19	898	794	781	60.5	80.9	65.6	.367	.592	.444	.71	.57	.71	S. W.	S. W.	S. S. E.	35 50	1.0			C. Cirr. 4.	C. C. Str. 10.	Cirr. 2.
20	654	593	618	63.2	70.9	61.3	.510	.544	.413	.88	.73	.77	S. S. E.	S. by E.	S. by E.	154.40	2 0	0.100		Cu. Str. 10.	" 8.	Cu. Str. 2.
21	717	704	842	51.1	77.9	69.0	.296	.632	.564	.79	.67	.79	N. by E.	N. E. by E.	S. E.	59 65	1.0			Clear.	" 4.	Str. 2.
22	810	796	845	54 6	79.1	68.0	.301	.651	.453	.71	.66	.79	S E.	S. S. W.	S. S. W.	107.86	1.0			"	" 9.	Cu. Str. 10.
23	705	565	424	54 1	58 0	56.0	.390	.459	.420	.93	.97	.94	S. S. W.	S. S. W.	S. S. W.	268.50	3.0	0 656		Nimb. 10.	Rain.	" 10.
24	558	568	614	64.1	83.6	63.0	.529	.802	.453	.89	.72	.94	S. W.	S. W.	S. by W.	201.50	2.5	0.094		C. Cirr 2.	Cirr. 4.	" 10.
25	630	604	632	80.0	77.8	62.4	.453	.632	.436	.85	.67	.80	S. S. W.	S. W.	S. W.	120.10	2.0			Rain.	Clear.	Str. 2.
26	694	679	762	68.4	81.7	60.9	.453	.451	.449	.80	.73	.85	S. S. W.	S. W.	S. W.	106.40	1.5	Inapp.		C. C. Str. 2.	Cirr. Str. 4.	Cu. Str. 4. Distant Thunder.
27	754	716	798	68.1	80.9	64.2	.485	.592	.529	.78	.57	.89	W. S. W.	W. S. W.	W. S. W.	199.00	2.0	0.400		Clear Heavy dew.	Clear.	" 10.
28	764	735	787	64.1	77.3	62.1	.464	.639	.491	.77	.69	.88	S. W.	S. W.	S. by E.	34.60	2.0	0.271		Cu. Str. 8.	Cu. Str. 10.	" 10.
29	799	652	703	64.0	78.9	67.2	.569	.863	.436	.97	.89	.94	S. by W.	S. S. W.	S. W.	25.60	2.0	1.157		Rain.	C. C. Str. 9.	C. Str. 10. Shower. Dist. Thu.
30	636	741	865	61.4	81.6	69.9	.449	.617	.592	.85	.58	.83	S. W.	S. W.	S. by W.	39.50	2 5			C. C. Str. 10.	" 9.	Clear.
31	885	874	907	84.6	90 1	70.1	.490	.834	.523	.81	.58	.72	N. N. W.	S. E.	S. S. W.	8.80	1.5			Clear.	Cum. 3.	"

REMARKS FOR JUNE, 1862.

Barometer....... Highest, the 16th day, 30·114 inches.
Lowest, the 30th day, 29.322 "
Monthly Mean, 29.713 "
Monthly Range, 0.792 "

Thermometer... Highest, the 28th day, 96°1.
Lowest, the 16th day,—96°2.
Monthly Mean, 84°61.
Monthly Range, 59°9.

Greatest intensity of the Sun's rays, 101°2.
Lowest point of Terrestrial radiation,—33°1.
Mean of Humidity, .660.

Amount of Evaporation, 4.16 inches.

Rain fell on 8 days amounting to 1.132 inches it was raining 18 hours 15 minutes and was accompanied by thunder on 3 days.

Most prevalent wind, S. W.

Least prevalent wind, the E.

Most windy day the 22nd day, mean miles per hour, 9.62.

Least windy day the 2nd day, mean miles per hour, Calm.

The Eclipse of the Moon was visible.

The Electrical state of the Atmosphere has indicated High Intensity.

Fire flies (*Lampyris Coruscar*) 1st seen 11th day.

REMARKS FOR JULY, 1862.

Barometer. ...... Highest, the 4th day, 30.062 inches.
Lowest, the 9th day, 29.307 "
Monthly Mean, 29.731 "
Montbly Range, 0.965 "

Thermometer. Highest, the 6th day, 94°0.
Lowest, the 14th day, 40°0.
Monthly Mean, 65°33.
Monthly Range, 54°6.

Greatest intensity of the Sun's rays, 102°1.
Lowest point of Terrestrial radiation,—37°4.
Mean of humidity, ·737.

Amount of Evaporation, 3.01 inches.

Rain fell on 12 days, amounting to 3.767 inches; it was raining 36 hours and 6 minutes and was accompanied by thunder on 5 days.

Most prevalent wind, S. W.

Least prevalent wind, S.

Most windy day, the 6th day; mean miles per hour, 11.81.

Least windy day, the 31st day. 0.37.

The Electrical state of the Atmosphere has indicated moderate intensity.

gins; and with these a new Amphipod, *Diplostylus*, having some characters of alliance with *Typhis* and *Brachyocelus*.

THE

CANADIAN

NATURALIST AND GEOLOGIST.

Vol. VII. OCTOBER, 1862. No. 5.

ARTICLE XXXI.—*Observations on the Geology and Physical Characteristics of Newfoundland.* By Moses H. Perley, Esq., President of the Natural History Society of New Brunswick, &c, &c.

This well-known Island lies on the north-east side of the entrance into the Gulf of St. Lawrence. It is separated from Canada by the Gulf; its South West point, Cape Ray, approaches Cape Breton; to the North and North East, are the shores of Labrador, from which it is divided by the Straits of Belleisle; and its eastern coast is washed by the North Atlantic.

Its form is somewhat triangular, but, without any approach to regularity, each of its sides being broken by numerous bays, harbours, creeks, and estuaries. In straight lines, as the sea-gull would wing its flight, its circuit is not much less than 1000 miles.

Its width at the widest part, between Cape Ray and Cape Bonavista, is about 300 miles. Its extreme length from Cape Race to Quirpen, at its north-east extremity, is about 419 miles, measured on a curve through the centre of the island. Its area is estimated at 36,000 square miles, equal to 23,040,000 acres.

Newfoundland is the nearest part of America to Europe, the distance from St. John's, the capital, to Valentia in Ireland, being only 1656 miles.

From the sea, Newfoundland has a wild and rugged appearance, which is anything but inviting. Of its interior, very little is known, as it has been but very partially explored. Such parts as have been visited by persons capable of giving a satisfactory description, were found much broken up with water; lakes, and marshes, rocks and scrubby trees, forming its chief features.

The prevailing character of Newfoundland is that of a rugged, and, for the most part, a barren country. Hills and valleys continually succeed each other; the former, but seldom rising into mountains, and the latter, rarely expanding into plains.

The hills, more or less lofty, are greatly varied in character. Sometimes they form long flat-topped ridges; occasionally, they become round and isolated, with sharp peaks and craggy precipices.

The valleys also vary greatly. Sometimes they present deep mountain gorges, and the wildest of ravines; while in others, they form depressions with gentle slopes toward the water, which is ever found flowing at their greatest depth.

The sea-cliffs of Newfoundland,—especially on the coast, between St. John's and Cape Race, thence westwardly, between Cape Race and Cape Ray, and thence northerly along the western coast and Bonne Bay,—are almost everywhere bold and lofty, with deep water close at their foot.

Loose rocks of all sizes, and with them huge boulders, are scattered all over the country. They increase the general roughness of its appearance, and give it a repulsive character.

This rough and rugged surface is covered by three different kinds of vegetation, which form three distinct districts.

The people of Newfoundland assign to these several districts, the names of, "Woods, Marshes, and Barrens."

The woods are in general found on the sides of hills, or the slopes of valleys, wherever there is natural drainage for the surplus water. For this reason, the forests, if they can be so called, occur most frequently, and the trees are of the greatest size, near the sea-coast, or near lakes and rivers, when the soil and other circumstances are favourable.

Newfoundland has been frequently described as a thickly wooded country, but such is not the case. The trees consist chiefly of spruce, (*Abies nigra,*)—white fir, (*Abies alba,*)—yellow birch (*Betula excelsa,*)—white birch, (*Betula populifolia,*)—and hackmatack or larch, (*Larix Americana.*) But what are considered large

trees on Newfoundland, and were pointed out to the writer as timber trees, would be laughed at by a New Brunswick lumberman, and not deemed worthy of his axe.

On the eastern or Atlantic coast of Newfoundland, there is but little wood of any value, except for fuel, and the building of fishing boats.

In the northern part of the island, on the limestone formation, it is said that formerly extensive forests existed, but that great fires destroyed the largest trees, and these have been succeeded by others of an inferior and much smaller species.

The greater part of the wood is of small and stunted growth, consisting chiefly of fir trees, about 20 or 30 feet high, and not more than 3 or 4 inches in diameter. In general, these insignificant trees grow so close together, that their twigs and branches interlace from top to bottom. The endless quantity of decayed trees, rotten stumps and branches, newly fallen trees, combined with the young shoots, and tangled brushwood, form very frequently a thicket that is almost impenetrable.

The trees are often covered with lichens, and tufts of white, dry moss, are entangled about the branches. Other green and softer mosses spread over the ground, concealing alike the gnarled and twisted roots of the standing trees, the pointed stumps of those that have fallen, the sharp edges and most slippery surfaces of the numerous rocks and boulders, and the holes and pit-falls between them.

Every step in the woods and wilds of Newfoundland is matter of toil and anxiety, requiring constant vigilance to avoid falling, and unremitting labour to find standing room. Climbing, creeping, and every other mode of progression, must be used to get onward. The course has constantly to be changed, and new directions are taken, in order to find those places through which to force a slow and tortuous way.

During the heat of summer, or what is called such in Newfoundland, the thickness of the low and stunted trees shuts out every breath of air, while they are not sufficiently thick at top to exclude the scalding rays of the sun. And this heated atmosphere is rendered more unpleasant by the strong smell of turpentine which emanates from every pore of the scrubby spruces and firs.

Such are the leading characteristics of what in Newfoundland are called "the woods." Embosomed in these woods, and cover-

ing the valleys and lower lands, are found large open tracts which are called "marshes."

Let it be understood that these marshes are not always low-lying lands, or even very level. They are frequently found at a considerable height above the sea, and often with an undulating surface.

Moss covers these marshes to the depth of several feet; it is green, soft, and spongy, and is bound together by straggling grass, and a variety of marsh plants. The surface is uneven, abounding in holes and hillocks, the tops of the hillocks being frequently covered with a short, dry, crisp moss.

The various colours of the mosses on these marshes, give them a peculiarly rich appearance, especially if seen from a distance, clothing the slopes of a hill with tufts or thin skirts of wood, scattered about. In such cases, a person not acquainted with the country would be led to believe it possessed great agricultural capabilities, and might be highly cultivated.

Except in long continued droughts or hard frosts, these marshes are always wet, and incapable of bearing the weight of a person walking across them. A march of three or four miles across a Newfoundland marsh, sinking into the moss at every step, always as far as the ancle, but sometimes knee-deep, is a most fatiguing operation, and most toilsome if a load has to be carried on the shoulders.

This thick coating of moss is precisely like a great sponge spread over the country. At the melting of the snow in spring, it becomes thoroughly saturated with water, which it long retains and which every rain-fall continually renews.

Numerous ponds of water are found everywhere in Newfoundland; and it is scarcely possible to walk a mile, in any direction, without encountering large pools, sometimes spreading out into very considerable lakes. In the lower parts small sluggish brooks or gullies are met with everywhere.

The extreme wetness of the marshes is due almost entirely to the spongy nature of the moss, as the slope of the ground is in almost every case quite sufficient for surface drainage.

Where the moss is stripped off these so-called marshes, either dry, rounded gravel, or bare rock, is generally found beneath.

Next we come to,—

The "barrens" of Newfoundland, which are extensive dis-

tricts occupying the summits of the hills and ridges, and other elevated and exposed positions. They are covered partially with a thin, scrubby vegetation, consisting of berry-bearing plants and dwarf bushes.

Bare patches of gravel and boulders, and crumbling fragments of rock, are frequently met with in the barrens, and generally they are altogether destitute of vegetable soil.

It is only by means of these barrens, these stony sterile tracts, that any large portion of the interior of Newfoundland can be visited or explored. Though frequently broken, rugged, and precipitous, they are delightful to tread upon after traversing the heavy marshes or toiling through the tangled and annoying woods.

Sometimes, in the hollows of the barrens, and in other places, where the disintegration of the rocks has created a little soil, a bed of dwarf hackmatack or larch is met with. These stunted trees are called in Newfoundland "tucking bushes;" they grow about breast-high, with strong branches at right angles to the stem, all stiffly interlaced, the tops being as flat and level as if they had been hewn off. These "tucking bushes" are so stiff that in some places one can almost walk upon them; but as this is not quite possible, the labour of pushing and thrusting through them can scarcely be conceived by those who have not made the attempt.

These different tracts, "woods, marshes, and barrens," are none of them of any great extent at any particular place; but they are continually alternating with each other in the course of a day's journey.

The most remarkable feature of Newfoundland is the immense and scarcely to be credited abundance of lakes of all sizes, all of which are called indiscriminately "ponds."

These are found universally over the whole country, not only on the valleys but on the highest lands, even on the hollows of the summits of the ridges, and on the very tops of the highest hills.

These ponds vary in size from pools of 50 yards in diameter to lakes upwards of 30 miles long, and 4 or 5 miles in width. The number of ponds which exceed a couple of miles in extent, must on the whole amount to several hundreds; those of smaller size are absolutely countless.

It has been estimated, that in Newfoundland the quantity of

ground covered by fresh water is fully one third of the island, and in this estimate I quite concur, believing it, if any thing, rather below the mark.

Taken in connection with this remarkable abundance of lakes and ponds, the scarcity of navigable rivers is almost anomalous. The broken and undulating character of the country with its craggy hills and deep ravines, is doubtless one cause of the absence of large rivers; while small rocky rattling streams are found in countless profusion.

Each lake, or small set of ponds, communicates with the sea by a valley of its own, of greater or less extent. Down this valley they send their superfluous waters, in what may be considered a mere brook. The general scantiness of these brooks, and the vast abundance of the ponds, are accounted for by the smallness of each system of drainage and the vast coating of moss found all over the country.

Upon every great accession of moisture, either from rain or melted snow, the chief portion is absorbed by this huge sponge; the residue fills the numerous ponds to the brink, and these discharge themselves gradually by the brooks.

Great periodical floods which would sweep out and deepen the channels of the rivers. are quite impossible, from the almost infinite number of small streams falling singly into the sea. These streams have not the power, at any time, of breaking down or overcoming the barriers which separate them, and so uniting their waters.

In dry weather, when the ponds begin to shrink, they are supplied by the slow and gradual drainage of the marshes, where the water has been kept as in a reservoir, to be given off when required. In this way, many ponds that have no great depth, and would otherwise be exhausted, are kept full of water in the driest seasons, and it is only in the greatest and most long continued droughts, when the marshes themselves begin to dry up, that the ponds are found to shrink much below their usual level.

CLIMATE.

As there are nearly five degrees of latitude between the southern and northern extremities of Newfoundland, there is of course a considerable difference in the severity and duration of winter. The climate of Conception Bay, which is in the south coast, and to the eastward of St. John's, the capital of the colony, is consi-

dered to afford what may be deemed the mean temperature of the island.

The weather there, although severe, is less fierce than in Lower Canada, and during winter, the extraordinary brilliancy of the Aurora Borealis, and the splendid lustre of the moon and stars, give a rare and peculiar beauty to the atmosphere.

The eastern coast of Newfoundland is much more humid than the western, owing to the heavy fogs which are driven in from the Grand Bank; and it is also more subject to violent gales and storms, owing to its exposed position. On the west coast, from Cape Ray to the north, and in the interior, the atmosphere is generally clear, and the climate is much the same as that of the district of Gaspé, in Lower Canada.

THE GEOLOGY OF NEWFOUNDLAND.

In the years 1839 and 1840, Mr. J. B. Jukes, a fellow of the Geological Society, who has since greatly distinguished himself in South Australia, was employed by the Government of Newfoundland to make a geological survey of the Island. The means placed at the disposal of Mr. Jukes by the Legislature, were exceedingly small, and it was only an ardent love of science, and a desire to do all that man could do, in an interesting but most difficult country, that induced Mr. Jukes to persevere as long as he did. Because Mr. Jukes, at the outset of his explorations, did not encounter anything of very great value, the Legislature declined to assist him in further researches, at the very point where those researches were beginning to be interesting, and becoming of practical value.

The only authentic account, therefore, of the Geology of Newfoundland, is that of Mr. Jukes, but to that has been added within a few years, the observations of other scientific men, who have been employed to explore certain sections of the island, with a view to discover its mineral wealth.

Mr. Jukes divides Newfoundland, geologically, into two sections, which are shown on the map by a line drawn from Cape Ray, the south-western angle of the island, to Quirpen, very nearly through the centre of the island.

To the south-westward of this line, the geological character of the country is such as to indicate a broken and sterile country, with but slight hope of mineral wealth; while to the Northward and eastward of the line, the country is composed of rocks of

much more recent character, including an extensive coal formation, with various indications of other minerals.

The aqueous or stratified rocks of Newfoundland consist of the following formations :—

The upper, and the lower, or red portion of the coal formation.

Next in the descending order, magnesian limestone. Then, an upper slate formation, consisting of shale and gritstone, and variegated shales.

Below these, a lower slate formation—and then the gneiss, and mica slate.

The unstratified, or igneous rocks, consist of various kinds of trap, greenstone, serpentine, hypersthene, porphyry, syenite, and granite.

The upper part of the coal formation consists principally of dark shales, with brown or yellow sandstones, or gritstones, in thin beds.

The lower part of this formation is characterised by beds of red sandstone, red and green marls, and gypsum.

These two portions of the coal formation pass by insensible gradations into each other.

Yellow, brown, and whitish flags and sandstones, dark blue clay, with an occasional bed of black shale, occur throughout the whole of the coal formation. Some of the lighter colored sandstones contain carbonate of lime, red and green marl, and large masses of gypsum in thick beds.

The total thickness of the coast formation is considerable, and the portion examined by Mr. Jukes had a thickness of 1000 to 1500 feet.

The magnesian limestone which was seen, was generally of a yellow colour, about 50 feet thick, in beds of 2 or 3 feet each, frequently splitting into flags.

One bed of carbonate of lime was found of a grey colour, about 2 feet thick, with a band of brown chert.

The upper slate formation is supposed to be below the coal formation in the series.

The superior portion consists of dark micaceous shale splitting into thin laminæ, with interstratified beds of a very fine grained grey gritstone, which increase in number, thickness and coarseness of grain, with the increasing depth, until the shale disappears altogether. The thickness of the two portions seen is estimated at several hundred feet.

The lower slate series is deemed by Mr. Jukes to belong to an older formation and to be composed of two groups.

1st. A mass of grey and red sandstone, which at the entrance to the harbour of St. John's, has a thickness of 800 feet.

And 2nd. The St. John slates, in which beds of red, green, and grey stone alternate near the junction of the sandstone and the slate rocks, forming the transition beds between the two. The thickness of this formation is estimated at between 2000 and 3000 feet.

The cleavage of the slate is frequently parallel to the line of stratification, and in these cases produces excellent roofing slate.

Veins of white quartz and masses of porphyry are found associated with these slates.

Descending lower in the Geological scale, there is found the mica slate and gneiss and also the igneous rocks, which do not differ from those usually found in other parts of the globe; the mica and the gneiss however alternate with and pass into each other.

Except in some indistinct vegetable impressions in the coal formation, no organic remains have yet been found in Newfoundland;* but it must be remembered that its rocks have not yet been subjected to the careful examination of modern geologists, nor yet to the keen scrutiny of some of the younger members of this society, whose well directed exertions have enabled them to discover evidences that animal life had existed in formations which were supposed to be far below the existence of any living thing.

The strike throughout the island rarely varies from a true N. N. E., and S. S. W. course.

Hence, all the other prominent features of the country run in the same direction, not only as regards the ranges of hills, but also the principal lakes; all the deep bays and the numerous valleys lie in the same line of bearing.

The strike of the cleavage is not invariably parallel to the strike of the beds; but the cleavage is much more constant as regards the strike and dip in relation to the points of the compass

* Trilobites of the Genus *Paradoxides* have been found in the older slate formation of Mr. Jukes, and several lower silurian fossils have been obtained by Mr. Richardson, of the Geological Survey of Canada, in the limestone formation of the North of the Island, described in the concluding part of this paper.

than it is in relation to the strike and dip of the beds, or than those latter are to the horizon, and points of the compass.

As regards the relative age of the igneous rocks, Mr. Jukes supposes that the granites are generally newer than the mica slate and the gneiss, which repose upon them.

The coal formation seems to be contemporaneous with those of western Europe, Nova Scotia, Cape Breton, and New Brunswick, and with the most modern group of stratified rocks in Newfoundland.

On the west coast of Newfoundland, as might have been prophesied by the most casual geological observer of the formations of Cape Breton and the adjacent shores of the mainland, there exists the continuation of the coal formation of New Brunswick, Nova Scotia and Cape Breton, the great coal basin of the St. Lawrence, probably the largest in the world, extending from the Bay of Chaleur to the profound solitudes, vast morasses, tangled forests and innumerable lakes, ponds, and brooks, which cover and intersect so great a portion of Newfoundland.

The province of Avalon is nearly separated from the rest of Newfoundland by the Bays of Placentia and Trinity, a narrow isthmus only between 3 or 4 miles in width, existing between those two deep and spacious bays, and thus connecting Avalon with the main body of Newfoundland.

In Avalon there are two principal ranges of hills, which form regular watersheds.

The most easterly range is that which rises from the back of Reneuse to Holyrood in Conception Bay. Though not lofty, this range is very rugged, the faces of the hills being abrupt and precipitious. Along this range are some remarkable hummocky hills called the "butter-pots," of which the passing voyager between Cape Race and St. John's has a capital view in fine weather. Each of these "butter-pots" has about the same height above the sea, probably rather more than 1000 feet.

The southern coast of Newfoundland has very lofty cliffs, and the high lands contiguous to the sea exclude all view of the interior from that quarter. Mr. Jukes declares his belief that the country is composed chiefly, if not entirely, of granite.

Three varieties of granite were observed; one white, rather fine grained, with abundance of mica; another of a coarse grain, with less mica and of a reddish colour; and the third, by far the most abundant, a somewhat coarse red granite with large imbedded crystals of flesh-coloured feldspar.

The country, from the Dead Islands to Port aux Basques and Cape Ray, is composed entirely of mica slate and gneiss; and these rocks continue around Cape Ray for some distance to the little Cadroy river where they terminate.

A chain of hills, called the Long Range, composed almost entirely of this gneiss and mica slate, runs into the country from Cape Ray and is believed to intersect and divide the whole Island.

The south side of St. George's Bay, between this Long Range and the Gulf of St. Lawrence, is occupied by the coal formation.

The cliffs on the sea-shore and a band of country a few miles wide, lying parallel to it, exhibit the lower beds of the coal formation, namely the red sandstones and marls, with gypsum.

In the cliffs, near Cadroy Island, (where the writer first landed in Newfoundland) there is much red and green marl, with bands of white flag-stone.

The white flag-stone, and the greenish marl, contain many veins of white fibrous gypsum, and interstratified with these and the red marls are some thirty beds of white and grey gypsum, of a singular character.

The Micmac Indians of this coast report a bed of coal, of two feet in thickness, some distance up the Cadroy river; but Mr. Jukes was unable to procure a guide to it. The bed is said to be of very considerable extent.

Mr. Jukes, however, penetrated the coal formation from Crabb's River, which is about half way up the south side of St. George's Bay. He found that at least six miles of the country, formed of the lower beds of this formation, must be crossed directly from the coast, before arriving at the higher beds, in which the coal is situated.

Having passed over the lower beds, Mr. Jukes at length arrived at a bed of coal, three feet in thickness, resting on soft brown sandstone, with ferruginous stains. Whether this seam of coal was the whole, or only the lower portion of a bed, could not be determined; but the quality was found to be good, as it proved a bright, caking coal.

The distance from the sea shore, where this coal was found, is about 8 miles; but the nearest and only harbour is that of St. George's, distant about 20 miles. From the best observations Mr Jukes was able to make, he concluded that the tract in which coal might be found, would be an oval, some 20

or 30 miles long, by 10 miles in width, bounded by the sea coast on the north, and the range of primary hills on the south.

Mr. Jukes penetrated the interior more to the north east, by the Grand Pond, and near its eastern extremity, on the banks of a small brook, discovered a seam of coal, *part of it resembling cannel coal*—and in the bed of the brook itself, which is rapid and rocky, large pieces of coal were found, clearly showing that more beds existed higher up the stream.

There is here a large district, throughout the whole extent of which it is probable coal may be found.

The north side of St. George's Bay is occupied by magnesian limestone, lying above the shale of the coal measures, in which shale it is alleged coal has been found at Port-aux-Ports.

The country between Port-aux-Ports and Bay of Islands, and thence northerly to Bonne Bay, and Cow Head—is lofty and unbroken, (the writer now speaks from his own observations) and is occupied chiefly by igneous rocks.

Around Lark Harbour, the rocks are high, pointed and precipitous, consisting of igneous rocks of the most varied character, the scenery is wild, picturesque, and in the elevated portions, sterile to the last degree. Down the deep and narrow ravines, the winds rush with fearful violence, and the suddenness of the gusts are such as to render the operation of beating into Lark Harbour very exciting.

From the neighbourhood of Lark Harbour, nearly to the head of Humber Sound (a magnificent piece of water, by the way, interspersed with numerous islands, having broad and deep channels between them, forming altogether wonderfully striking scenery of unusual character) the rocks consist of dark brown and red schist or shale, grey gritstones, and black, grey, and red slate. Beyond this commences the great calcareous formation, which is supposed to form almost the entire north eastern extremity of Newfoundland.

At the north of the Humber, by far the largest river in Newfoundland, this formation consists of beds of limestone, containing veins and flakes of mica, so entangled with quartz rocks, and intimately associated with the gneiss and mica slate, as to leave no doubt of its being entitled to the denomination of a primary limestone.

The highest beds of this limestone are of a hard dark grey colour, with brown concretions, that on a surface which had

for some time been exposed to the weather, stood out in bold relief.

Below these higher beds, are some thin beds of hard sub-crystalline limestone—some white, and some flesh coloured with white veins.

These thin beds have a thickness of about 100 feet, and from the thickness of the beds they are especially adapted for marble slabs, as they would take a good polish, and be highly ornamental.

Below this formation lies a few feet of thin-bedded black marble, of similar qualities.

Still farther down come large masses of grey compact limestone, having a thickness of 300 or 400 feet, passing into a perfectly white saccharine limestone, without any mark of stratification, and but few joints, or division lines of any kind.

About three miles up the Humber River, it forms lofty white precipices, of pure marble, crowned and surrounded by thick woods, which, closing in upon the rapids, produce most picturesque scenery.

Blocks of this magnificent marble, of any size required, might be procured here, and readily floated down the river into the sound, where vessels of any size may find safe and excellent anchorage.

From Cow Bay northward, along the west coast of Newfoundland, the coast is low, and altogether of primary limestone, which appears to form a belt of two or three leagues in width, bounded by a lofty ridge of mica slate, gneiss, and their associated rocks, forming apparently a continuation of the Long Range, and extending to Lake Quirpon, the extreme northern point of the island of Newfoundland.

This country has not yet been examined by any geologist, and the writer speaks of its general features from observations made while passing to and fro through the straits of Belleisle.

Having thus briefly and imperfectly pointed out the leading geological features of Newfoundland, it only remains to say that in addition to the gypsum which is found abundantly at Cadroy, and the splendid white marble of the Humber, ores of copper, in different varieties, have been found in several districts, and explorations are being carried on by various parties, whose discoveries have not yet been made public.

An extensive deposit of lead was found at La Manche in Pla-

centia Bay, on the southern coast, which was worked for a short time by an American company, who carried away from it many hundred tons of valuable ore.

The people of Newfoundland are sanguine that gold will be found in their island, which is quite possible; the geological character of the island, in some of its characteristics, might warrant the belief, and induce some exertions to explore it more thoroughly.

Any notice of Newfoundland would be imperfect without an allusion to its fisheries, which furnish employment to its people, and provide its staple export. The Arctic current which passes swiftly and continuously along its eastern coast, rendering that side cold, damp, and cheerless—the dense fogs occasioned by this icy current meeting the lighter and warmer waters of the Gulf stream—the long, deep, and narrow arms of the sea, which penetrate far into the land, in every part of the island, and resemble very closely the "fiords" of Norway and Sweden, in all their principal features, affording the best and safest of harbours,—together with the fish and fishing of Newfoundland—will furnish ample materials for other papers hereafter.

[While the above paper was in the hands of the printer, intelligence reached us of the untimely decease of its able and accomplished author. Mr. Perley was a man eminent for his powers of observation, and possessed a vast store of information on the physical features and resources of the maritime provinces, which he was ever ready to render useful to his countrymen. He is well known in British America, and abroad, as the author of valuable reports on the fisheries, on timber trees, on emigration, and other subjects of public importance. The paper which we now publish was read before the Natural History Society of New Brunswick, not long before his departure on what was destined to be his last journey, and was kindly sent by the Council of the Society for publication in the Naturalist.—Editors.]

ARTICLE XXXII.—*Review of Hooker's Outlines of the Distribution of Arctic Plants.**

In this paper Dr. Hooker presents a most valuable summary of the Arctic Flora, entering in great detail into its wonderful geographical distribution, and very properly re-uniting in his lists many varietal forms that have been promoted too hastily to the

* Outlines of the Distribution of Arctic Plants. By J. D. Hooker, M.D., F.R.S.—*Transactions of the Linnæan Society. London*, 1862.

rank of distinct species. Dr. Hooker also enters on the questions as to the antiquity and migrations of the species of this flora, and the variations which they may have undergone in the lapse of time. From many of his conclusions on these points, however, geologists who have investigated the post-pliocene deposits of Europe and America will find themselves obliged to dissent, as well as from the assumption, for it is nothing more, of the unlimited variation of species in a Darwinian sense, which pervades the paper, notwithstanding the positive geological testimony to the permanence of several of these throughout a great lapse of geological time. We take the following extracts and summaries from an able condensation of the paper by Prof. Gray, in the American Journal of Science :—

'The immediate subjects of the treatise are the Arctic plants, of every phænogamous species known to occur spontaneously anywhere within the Arctic circle; the geographical distribution of which, so far as known, is carefully indicated: 1. Within the Arctic region, under the several divisions—Europe, Asia, W. America (Behring's Straits to the Mackenzie River), E. America (Mackenzie River to Baffin's Bay), and Arctic Greenland. 2. Without this circle, and under the general divisions of N. and Central European and N. Asiatic Distribution, with three longitudinal subdivisions; American Distribution, with appropriate subdivisions; S. European and African Distribution; Central and S. Asiatic Distribution. The theory upon which the facts are collocated and discussed, and which they are thought strongly to confirm, is that of Edward Forbes, which was completed, if not indeed originated by Darwin :*—" first, that the existing Scandinavian flora is of great antiquity, and that previous to the glacial epoch it was more uniformly distributed over the Polar Zone than it is now; secondly, that during the advent of the glacial period this Scandinavian vegetation was driven southward in every longitude, and even across the tropics into the south temperate zone; and that, on the succeeding warmth of the present epoch, those species that survived both ascended the mountains of the warmer zones, and also returned northward, accompanied by aborigines of the countries they had invaded during their southern migration. Mr. Darwin shows how aptly such an explanation meets the difficulty of accounting for the restriction of so many American and

* This is scarcely correct. The theory of distribution originated by Forbes should be distinguished from the extension of it suggested by Darwin. Eds.

Asiatic arctic types to their own peculiar longitudinal zones, and for what is a far greater difficulty, the representation of the same arctic genera by closely allied species in different longitudes.* * * Mr. Darwin's hypothesis accounts for many varieties of one plant being found in various alpine and arctic regions of the globe, by the competition into which their common ancestor was brought with the aborigines of the countries it invaded. Different races survived the struggle for life in different longitudes; and these races again, afterwards converging on the zone from which their ancestor started, present there a plexus of closely allied but more or less distinct varieties, or even species, whose geographical limits overlap, and whose members, very probably, occasionally breed together." A further advantage claimed for this hypothesis is, that it explains a fact brought out by Dr. Hooker in a former publication, viz.: "that the Scandinavian flora is present in every latitude of the globe, and is the only one that is so.'

'Moreover, Dr. Hooker, discovers in the flora of Greenland a state of things explicable upon this hypothesis, but hardly by any other, viz.: its almost complete identity with that of Lapland; its general paucity, as well as its poverty in peculiar species; the rarity of American species there; the fewness of temperate plants in temperate Greenland; and the presence of a few of the rarest Greenland and Scandinavian species in enormously remote alpine localities of West America and the United States. Our author reasons thus: "If it be granted that the polar area was once occupied by the Scandinavian flora, and that the cold of the glacial epoch did drive this vegetation southwards, it is evident that the Greenland individuals, from being confined to a peninsula, would have been exposed to very different conditions from those of the great continents. In Greenland many species would, as it were, be driven, into the sea, that is, exterminated; and the survivors would be confined to the southern portion of the peninsula, and, not being there brought into competition with other types, there could be no struggle for life amongst their progeny, and, consequently, no selection of better adapted varieties. On the return of heat survivors would simply travel northwards, unaccompanied by the plants of any other country.'

'The rustic denizens of Greenland, huddled upon the point of the peninsula during the long glacial cold, have never enjoyed the advantages of foreign travel; those of the adjacent continents on either side have 'seen the world,' and gained much improve-

ment and diversity thereby. Considering the present frigid climate of Greenland, the isotherm of 32° just impinging upon its southern point, its moderate summer and low autumnal temperature, we should rather have supposed the complete extermination of the Greenland ante-glacial flora; and have referred the Scandinavian character of the existing flora (all but eleven of the 207 arctic species, and almost all those of temperate Greenland, being European plants,) directly to subsequent immigration from the eastern continent. Several geographical considerations, and the course of the currents, which Dr. Hooker brings to view on p. 270, would go far towards explaining why Greenland should have been re-peopled from the Old rather than from the New World. While the list (on p. 272, 273) of upwards of 230 Arctic European species which are all likewise American plants, but are remarkable for their absence from Greenland, would indicate no small difficulty in the westward migration, and render it most probable that the diffusion of species from the Old World to the New was eastward through Asia, for the *arctic* no less than (as has elsewhere been shown) for the *temperate* plants. Was it that Greenland and the adjacent part of the American continent remained glacial longer than the rest of the zone? And if our northern regions were thus colonized by an ancient Scandinavian flora, this seems to have been in return for a still earlier donation of American plants to Europe, to which a very few existing but numerous fossil remains bear testimony. Speculative inquiries of this sort are enticing, and the time is approaching in which they may be fruitful.'

'Indeed, the characteristic features and the immediate interest and importance of the present memoir, as of others of the same general scope and interest, are found in this: 1. That the actual geographical distribution of species is something to be accounted for; 2. That our existing species, or their originals, are far more ancient than was formerly thought, mainly if not wholly antedating the glacial period; and, 3. That they have therefore been subject to grave climatic vicissitudes and changes. There may be many naturalists who still hesitate to accept these propositions, as there as one or two who deny them; but these or similar conclusions have evidently been reached by those botanists, paleontologists, and geologists in general who have most turned their thoughts to such enquiries, and who march foremost in the advancing movement of these sciences. In this position, the author of the

present memoir—prepossessed with Darwin's theory of the diversification of species through natural selection—having occasion to revise systematically the materials of the arctic flora, is naturally led to compare the new theory with the facts of the case in this regard; to see how far the vicissitudes to which it is all but demonstrated that the plants of the northern hemisphere have long been subjected, and the modifications and extinctions which he thinks must have ensued under such grave change and perils, during such lapse of time, may serve to explain the actual distribution of arctic species and the remarkable dispersion of many of them. That the enquiry is a legitimate and a hopeful one we must all agree, whether we favor Darwinian hypotheses or not. How well it works in the present trial we could not venture to pronounce without a far more critical examination than could now be undertaken. But there are good reasons for the opinion that this is just the ground upon which the elements of the new hypothesis figure to the best advantage.'

'The mass of facts, so patiently and skilfully collected and digested in this essay, have a high and positive value, irrespective of all theoretical views. We cannot undertake to offer an abstract, but may note here and there a point of interest. The flowering plants which have been collected within the arctic circle number 762, viz.: 214 Monocotyledons, and 548 Dicotyledons. They occupy a circumpolar belt of 10° to 14° of latitude. The only abrupt change in the vegetation anywhere along this belt is at Baffin's Bay, the opposite shores of which present, as has been already intimated, an almost purely European flora on the east coast, but a large admixture of purely American species on the west.'

"Regarded as a whole, the arctic flora is decidedly Scandinavian; for Arctic Scandinavia, or Lapland, though a very small tract of land, contains by far the richest arctic flora, amounting to three-fourths of the whole." This would not be very surprising, since this is much the least frigid portion of the zone, and has the highest summer temperature; but "upwards of three-fifths of the species, and almost all the genera of Arctic Asia and America are likewise Lapponian;" so that the Scandinavian character pervades the whole.'

'In the section on the local distribution of plants within the arctic circle, Dr. Hooker shows that there is no close relation dis-

coverable between the isothermal lines (whether annual or monthly) and the amount of vegetation, beyond the general fact that the scantiness of the Siberian flora is associated with a great southern bend in Asia, and its richness in Lapland, with an equally great northern bend there, of the annual isotherm of 32°. Yet "the same isotherm bends northwards in passing from Eastern America to Greenland, the vegetation of which is the scantier of the two; and it passes to the northward of Iceland, which is much poorer in species than those parts of Lapland to the southward of which it passes." A glance at the supposed former state of things would suggest the explanation of all that is anomalous here.'

" The June isothermals, as indicating the most effective temperatures in the arctic regions (when all vegetation is torpid for nine months, and excessively stimulated during the three others) might have been expected to indicate better the positions of the most luxuriant vegetation. But neither is this the case; for the June isothermal of 41°, which lies within the arctic zone in Asia, where the vegetation is scanty in the extreme, descends to lat. 54° in the meridian of Behring's Straits, where the flora is comparatively luxuriant." The aridity of the former, and the humidity of the latter district here offers an obvious explanation; also the great severity of the winter in the former, and its mildness in the latter. And Great Britain, in which a far greater diversity of species are capable of surviving without protection than in the Eastern United States under the same annual isotherms, indicates the advantage of a mean over an extreme climate in this respect, if only there be a certain amount of summer heat. For lack of that, doubtless, very many of the introduced denizens of Britain would soon disappear, if deprived of human care.'

" The northern limit to which vegetation extends varies in every longitude; the extreme is still unknown; it may, indeed, reach to the pole itself. Phænogamic plants, however, are probably nowhere found far north of lat. 81°. Seventy flowering plants are found in Spitzbergen; and Sabine and Ross collected 9 on Walden Island, towards its northern extreme, but none on Ross's Islet, 15 miles further to the north."

" *Saxifraga oppositifolia* is probably the most ubiquitous, and may be considered the commonest and most arctic flowering plant." There are only eight or nine phænogamous species peculiar to the arctic zone, and only one peculiar genus, viz.: the grass, *Pleuro-*

*pogon.** Of the 762, found south of the circle, all but 150 have advanced beyond lat. 40° N., in some part of the world; about 50 of them are identified as natives of the mountainous regions of the tropics, and 105 as inhabiting the south temperate zone.'

"The proportion of species which have migrated southward in the Old and New World also bear a fair relation to the facilities for migration presented by the different continents." The tables given to illustrate this "present in a very striking point of view the fact of the Scandinavian flora being the most widely distributed over the world. The Mediterranean, South African, Malayan, Australian, and all the floras of the New World, have narrow ranges compared with the Scandinavian, and none of them form a prominent feature in any other continent than their own. But the Scandinavian not only girdles the globe in the arctic circle, and dominates over all others in the north temperate zone of the Old World, but intrudes conspicuously into every other temperate flora, whether in the northern or southern hemisphere, or on the Alps of tropical countries." * * * "In one respect this migration is most direct in the American meridian, where more arctic species reach the highest southern latitudes. This I have accounted for (Flora Antarctica, p. 230) by the continuous chain of the Andes having favored their southern dispersion."

'In presenting the actual number of arctic species, and in delineating their geographical ranges, the question, what are to be regarded as species, becomes all important. As to this, it does not so much matter what scale is adopted, as to know clearly what the adopted scale is. Here we are not left in doubt. Taking European botanists by number, we are confident that nine out of ten would have enlarged the list of 762 phænogamous arctic species to 800 or more, and would not have recognized a goodly number of the synonyms adduced, thereby considerably affecting the assigned ranges, especially into temperate and austral latitudes. In this regard we should side with Dr. Hooker on the whole, but with differences and with questionings—with halting steps follow-

* '*Douglasia* is mentioned in another place (p. 269) as an absolutely peculiar arctic or arctic alpine genus of E. America. But we have considered this genus as identical with *Gregoria*, of Duby. It would appear as if these two genera were established in the same year, since Lindley himself, in the Botanical Register, refers to Brande's Journal for January, 1828, for his original article. But this article will be found in the volume of that Journal for 1827; so that the name *Douglasia* is to be adopted, if the genus is sufficiently distinct from *Androsace*.'

ing his bold and free movement, but probably arriving at the same goal at length. Indeed, we freely receive the view which Dr. Hooker presents as appropriate to his particular purpose, and as the most useful expression of our knowledge of the relationships of the plants in question, when collocated in reference to the ideas upon which this memoir is based.'

Among the geological objections to the general conclusions views of Dr. Hooker, we may state the following:

1. The modern distribution of plants in the arctic regions is plainly related to the more or less equable temperature, greater moisture or dryness, and varying soil and geological structure, of portions of this area, in connection with the direction of ocean currents, of prevailing winds, and the migrations of animals. When we consider the distribution of arctic plants to the southward, and the peculiarities of their position in respect to meridians, we have farther to take into account the great post-pliocene subsidence and the distribution of coast lines and ocean currents at that period, as well as the cold climate, which is only one element, and a subordinate one, in the decision of the question.

2. The present flora of Scandinavia is related to its varied levels and soils, and to the moderation of its climate by the action of the gulf stream. In the glacial period its level was reduced by several hundreds of feet, and its climate was probably as cold as that of Greenland. Consequently, though the species inhabiting Scandinavia, or many of them, are no doubt ancient, their residence in Scandinavia may be modern, and there are no facts to show which of them resided there before the glacial period began.

3. The distribution of the sub-fossil shells of the post-pliocene, shows a shore connection between Scandinavia and Greenland, and at the same time a great depression of temperate Europe and America.* That is, there was much arctic land and little in the temperate zone. This geographical arrangement was no doubt, as Sir C. Lyell argues, the actual cause of the cold of the period. It was consequently impossible that plants could migrate southward except as seeds floated over the ocean, because they were cut off by wide seas from all southern land. Nor did they so need to migrate, for the cold of the glacial period did not necessarily imply extremes fatal to them, even in the arctic regions, though it produced conditions favourable to them in the islands that remained far to the southward.

* See Canadian Naturalist, vol. 5, p. 199.

4. In the post-pliocene period Greenland was either under water, or if land quite as suitable as now for arctic plants. Most probably it was in the latter case. Scandinavia had in that period a much less advantage, if any, over Greenland in point of climate than at present, and was probably connected with it by land or chains of islands, while there is no reason to suppose that Greenland was then connected with America. The flora of neither region could migrate to the south over the plains, because they were submerged, unless indeed covered with that general glacier which Agassiz at one time advocated, and Ramsay has recently proposed to revive. That these plants migrated by means of drift ice far to the south, there is good reason to believe;* but if they were extirpated from their arctic homes, they could not have returned in that way against the prevailing currents, nor could they have returned over the emerged plains, which would have been too warm and dry. They could have returned by only one agency, that of migratory birds, an agency which though not needed for this purpose, has probably done much to give Lapland its rich flora, as well as to scatter arctic plants to the south along certain meridians.

5. The law of distribution of arctic plants must always have been different in America and the eastern continent, owing to the north and south character of the coast lines and mountains in the former, and the opposite arrangement in the latter, with the varied effects of these different arrangements on climates and on geological subsidences and elevations. It could easily be shown that this fact accounts for many apparent anomalies.

6. It is farther to be observed that difference of geological formation, and difference of soil as depending on this, constitute great determining causes in the distribution of plants, as well as in their variations. Until the botanical geographer pursues his studies of distribution with a geological map in his hand, and a knowledge of the habitudes of plants in reference to soils, his labours will be to a great extent fruitless. A little more lime or a little less alkali in the soil renders vast regions uninhabitable by certain species of plants. For many of the plants of our Laurentide hills to extend themselves over the calcareous plains south of them, under any imaginable conditions of climate, is quite as far beyond the range of possibility as to extend across the wide ocean. A multitude of apparent anomalies belong to this cate-

* See Can. Nat., April, 1862.

gory, and it becomes specially important when we consider that so perfect are the arrangements for the migrations of plants, that they will discover and colonise every suitable spot, however small and however distant, and that the struggle for existence is really not between one plant and another, but between all plants and external conditions, of which soil is one of the most important.

Lastly, the actual geographical distribution of Arctic plants is very imperfectly known, except for a limited district in the west of Europe, and the evidence from fossil remains as to the distribution in the post-pliocene period is almost nothing. To this must be added the uncertainty that attends the determination of species in the case of plants so widely distributed. Though no one more competent than Dr. Hooker could undertake the task of comparison and generalistation, we venture to say that every one of his local lists will be open to serious objections and corrections of local botanists, where there are any, and where there are none the risk of error must be ten-fold greater. For example, in a list of a few Greenland species, said to occur only in one other locality beside, we find *Potentilla tridentata* and *Arenaria Greenlandica.* The former of these occurs not only in Greenland and Labrador, but in the White Mountains, on the coast of Maine, in Nova Scotia, and various places north of Canada, and it is one of the few species that are known to have inhabited Canada in the post-pliocene period. The latter is also found on the coast of Maine, and no doubt in many places between that and Greenland. Only a few months ago the discovery of *Calluna vulgaris*, the common heather of the old country, was reported in a locality in New England supposed to have been well explored ; but this plant has been stated to occur in Newfoundland, and many years ago the writer was informed by local collectors that it occurs in Cape Breton. No doubt it may be found along the coast of north-eastern America everywhere where conditions are favourable, which can be however only in a few exceptional localities on the coast, and these somewhat out of the way of ordinary collectors.

In conclusion, Dr. Hooker deserves our thanks for his able and original treatment of his subject; but the problem is very intricate, and we believe that he has not sufficiently weighed some of the elements for its solution, and has been disposed instead to lean on the hypothesis, which however specious and apparently useful in explaining difficulties, has not yet been proved by a single tangible fact, that under certain circumstances two real

species may spring from one. We remarked the same defects some time ago in the author's introduction to his Australian flora. The time was when it was the failing of naturalists to separate varieties from each other as species, in order to avoid difficulties of distribution. Now the opposite tendency prevails, to account for the number of species by their supposed mutability and migrations. So science in its progress always sways between extremes, and the middle way of truth appears only after these oscillations have spent themselves. J. W. D.

ARTICLE XXXIII.—*On the Mammals and Birds of the District of Montreal.* By ARCHIBALD HALL, M.D., L.R.C.S.E.

(*Continued from page* 316.)

Picus pubescens. Downy Woodpecker.
P. (*Trichopicus*) *pubescens.* Baird!

V.S.P Bill black; legs and feet bluish; irides hazel; eggs 6, white.

Dorsal aspect. Frontlet brownish white; crown of head jet black, bordered laterally by a white streak commencing over the eye, and posteriorly by a crescent of crimson with which the white streaks are continuous; immediately behind the eye a broad black streak begins, and including the auriculars, terminates below the crimson crescent on the nape of the neck, meeting its fellow of the opposite side; sides of neck white, the white projecting backwards to the nape of the neck, where it is intersected by a narrow mesial line of black; interscapular region black, the centre feathers black; scapulars and rump black; small wing coverts black, the lowest row tipped with white; greater wing coverts black with a large white spot towards their tips; primaries and secondaries brownish black barred with white; the two lateral tail feathers, and a spot on the third white, with rudimentary black bars; all the other feathers black.

Ventral aspect. White, usually soiled on the chin and throat; the feathers as well as those of the interscapulary region very silky.

3rd primary longest; 4th next; 2nd next; 1st shorter than the 6th. Length 6½ inches; alar expanse 10 inches. In the female the occipital band is black.

P. pileatus. Cock of the woods.—Pileated Woodpecker.
Hylatomus pileatus. Baird!

V.S.P. Bill bluish black above, paler below; legs and feet bluish black; irides (golden?) hazel; eggs 6, white.

Dorsal aspect. Crown and crest crimson; line round the eye including the auriculars and meeting its fellow on the nape of the neck below the crest, brownish black, and separated on the side of the head from the crown by a narrow streak of white, which commences over the eye and terminates above the auriculars; moustaches crimson; a whitish line from the nostrils passes between the moustaches and eye and auriculars, expands on the side of the neck, and soon contracting descends to the shoulders and is lost under the wings; nape of neck, interscapulary region, rump, scapulars, wing and tail coverts brownish black—in the specimen before me, bronze; primaries and secondaries brownish black, with their basal halves cream white, and a tip of soiled brownish white on the 2nd, 3rd and 4th primaries; tail black; the white of the wings concealed by the great wing coverts.

Ventral aspect. Chin white; throat, breast, belly, vent, and tail coverts brownish black; the feathers on the belly tipped with white; wing coverts white; wings half cream white and half brownish black.

1st primary very short; 2nd and 7th subequal; 4th longest; 3rd and 5th subequal. Length from extremity of bill to extremity of tail 18¼ inches; alar expanse 27½ inches. The moustaches of the female and young bird are dusky.

2nd Section.—Tridactylœ.

P. tridactylus. Northern Three-toed Woodpecker.
Picoides arcticus. Baird!

V.S.P. Bill, legs and feet bluish black; irides deep hazel; eggs 4 to 5, white.

Dorsal aspect. Crown of head rich golden yellow; occiput, nape of neck, interscapulary region, rump, wing and tail coverts glossy black with blue and purple reflections; primaries and secondaries black, the former and a few of the latter barred with white; the lateral tail feathers and the distal halves of the 2nd and 3rd white, usually much sullied; the centre feathers black.

Ventral aspect. A white line from the nostrils down the side of the neck, followed by a black one from the angle of the mouth,

both lost upon the shoulders; chin, throat, middle of breast, belly, and vent white; sides of the breast and flanks white with black bars; shoulders black; central tail coverts white; the lateral ones white barred with black on their inner vanes.

1st primary rudimentary; 3rd to 4th subequal and longest. Length $9\frac{3}{4}$ inches; alar expanse $14\frac{1}{2}$ inches. The female has the head wholly black.

P. hirsutus. Northern Banded Woodpecker.
P. hirsutus. Viellot!
Picoides hirsutus. Baird!

D.C. Crown yellow, spotted with white; throat and beneath white, barred with black on the flanks; the four middle tail feathers black; outer feathers white.

Female smaller; head black with white spots.

Length 9 inches; alar breadth 15 inches.

The above description is taken from Audubon's work. The following is a description of a young male now before me:

V.S.P. Dorsal aspect. Prevailing tint black; crown of head spotted with white; from behind the eye reaches a streak of white meeting a circle of white at commencement of the dorsal region; back barred with white; tail coverts black; the three outer tail feathers with their outer vanes white or soiled white; the outermost feather wholly white with the exception of three or four black bars on the inner vanes; central feathers black with an occasional whitish spot; the primaries and secondaries with white spots, the former on both vanes; the latter on the inner only.

Ventral aspect. Throat and breast white; flanks and ventral portion white barred with black; hinder tail coverts white.

This bird has only three toes, and has the bill straight, somewhat flattened, with the upper bill acutely ridged; the nuchal bristles stand forwards, closely appressed and bristly.

Length $7\frac{1}{2}$ inches; alar expanse 13 inches.

The bird before me was shot last autumn (1861) on St. Helen's Island, opposite this city, and presented to Mr. Hunter of the Natural History Society. Its sex was verified by Mr. Hunter, and it therefore in almost every respect resembles the adult female. It must have been a bird hatched last summer. I cannot but regard this species as extremely rare visitants.

Genus Cuculus.

Gen. char. Bill as long as the head, compressed and curved, and carinate above and below; nostrils basal, lateral, oval, and surrounded by a naked and prominent membrane; tarsi feathered below the knee; feet slender; outer toe versatile; interior and middle connected at base; tail cuneiform; 3rd primary longest.

C. Dominicus. St. Domingo Cuckoo.
Coccygus Dominicus of Nuttall!
Cuculus erythropthalmus of Wilson!
Coccygus erythropthalmus. Baird!

V.S.P. Bill, feet and legs bluish black; irides light hazel; eggs 3 to 5, bluish green.

Dorsal aspect. Over the whole surface light bronze colour, exceedingly glossy; tail cuneiform, of the dorsal tint, tipped with white.

Ventral aspect. White, tinged with bronze on the chin and throat; wing and tail coverts yellowish white.

A naked space round the eyes of a vermillion colour; 3rd primary longest; 4th next; 2nd shorter than the 6th; 1st equal to the secondaries. Length 11½ inches; alar expanse 14½ inches. This bird does not appear to possess the characteristic of other cuckoos; viz., in laying her eggs in the nests of other species, but on the contrary, prepares her own nest, hatches her own eggs, and tends her young ones with the most maternal anxiety. It is addicted however to the practice of sucking the eggs of other birds.

Coccygus Americanus. Yellow-billed Cuckoo.
Cuculus Carolinensis. Wilson.

V.S.P. ET M. Upper part of upper mandible, and tip of lower black; lower part of upper, and all the lower except the tip yellow; irides hazel; eggs 2 to 4, bluish-green.

Dorsal aspect. Whole dorsal aspect greyish-brown, with greyish-bronzy reflections, which are almost absent on the tail coverts. Two middle tail feathers of the dorsal tint, all the others blackish. The 3 exterior feathers largely, 4th minutely, tipped with white; the outer tail feathers half the length of the middle ones; the greater portion of the vanes of the primary, and nearly all the secondaries, bright rufous colour.

Ventral aspect. White. The two central tail feathers whitish, tipped with black. The rufous part of the rings is scattered be-

low; inner wing coverts white, tinted with nankeen. Feathers of leg long dusky white.

Length 12 inches: alar expanse about 16 inches. This description is taken from a female. The male has all the dorsal feathers, except the two centre ones, broadly tipped with white By no means a common bird in this vicinity.

Ord. IV. Gallinaceæ.

Genus Tetrao.

Gen. char. Bill short, thick, arched above, entire, and naked at base; nostrils basal, semiclosed by a membrane, and partly concealed by the small projecting frontlet feathers; eyebrows naked, studded with scarlet papillæ; tarsi feathered and destitute of spurs; 3 toes before and one behind; front toes connected at the base, all of them pectinated on both inferior margins; 3rd and 4th primaries longest; tail consisting of 15 to 18 feathers.

Sub genus Tetrao.

Sub gen. char. With the lower portion of the tarsus and the toes naked.

T. umbellus. Ruffed Grouse.
Bonaza umbellus. Baird!

v.s.p. Bill horn colour; legs and feet livid; irides hazel; eggs 10 to 15, dull yellow.

Dorsal aspect. Crown of head crested, waved with black, grey and brown, the first colour predominating; on the nape and sides of the neck, there is a similar intermixture of colours, but a predominance of white tinged with brown; interscapulary region and rump brown, with very minute wavy black lines, with a triangular spot of whitish in the centre of each feather towards the tip; inner vanes of the scapulars black towards the ends, waved black and brown internally; outer vanes with a streak of cream white near the shafts bordered by black, and finally edged with brown sprinkled with black; great and small wing coverts brown, streaked and sprinkled with black on the inner vanes, brown sprinkled with black on the outer vanes, with a central streak of white; tail round, grey, banded narrowly with black, and sprinkled with black in the interstices of the bars, with a broad terminal band of black feathers being lastly broadly tipped with grey sprinkled with black; primaries and secondaries dusky brown; the six first primaries spotted with cream white on their

outer vanes; the outer vanes of the secondaries edged with brown sprinkled with black; on the few last secondaries the tips of the inner vanes are similar to the outer vanes, and on the outer vanes a large spot of black.

Ventral aspect. A streak from the nostrils to the eye, and from the eye above the auriculars cream white; cheeks and auriculars black mixed with brown; chin, upper part of throat. and sides of throat rufous; on each side of the lower part of the neck a ruff of black feathers with purple reflections; lower part of throat anteriorly, rufous edged with black; breast brownish white barred near the end with rufous, and lastly tipped with pure white; sides of the breast under the wings, rufous with a streak of white along the shafts, and minutely sprinkled with black at the tips and along the edges; belly and flanks white with a brownish band of rufous and tipped with white; vent rufous white; tail coverts rufous tipped with white, the white running up the shafts for some distance.

3rd and 4th primaries subequal and longest; 2nd and 6th equal; 1st and 7th equal; the shafts of the wing feathers incurved; wing itself much rounded. Length 17¾ inches; alar expanse 23 inches. The female bears a great resemblance to the male. The ruff, however, is smaller and browner. The general hue of the bird varies considerably. In the specimen before me a rufous tint prevails. The most usual predominant tint is a chesnut brown. In those specimens where the plumage is tinged with chesnut, the tail partakes of a light brown hue. In this species the eyelids are not naked.

T. Canadensis. Spruce Partridge.—Spotted Grouse.
T. Canadensis. Baird!

V.S.P. Bill horn colour, dark; feet and legs livid brown; irides hazel; eggs 5, varied with white, yellow and black.

Dorsal aspect. Crown of head, nape of neck, interscapulary region and rump, black waved with grey, darkest on the head and back, and lightest on the neck and rump; the feathers of the rump are black barred semicircularly, and tipped with grey; scapulars, and greater and smaller wing coverts black waved with chesnut; tail coverts black, barred with grey; tail round, black, with a broad terminal tip of bright chesnut; a spot above each nostril, a streak below the eye, and another above the auriculars, white; a naked spot above the eye bright vermillion; cheeks and chin black.

Ventral aspect. A semicircle of white meets on the throat, commencing at the auriculars; feathers of throat black tipped with white: those of the upper and lower parts of the breast black; sides of breast black, broadly tipped with white, meeting on the centre of the breast causing a banded appearance; feathers of body and vent black tipped with white; flank feathers black waved with chesnut, and a streak of white down the shafts; tail coverts black broadly tipped with white.

3rd and 4th primaries longest; 1st and 8th equal; 2nd and 6th equal; quills incurved, dusky brown, the six first primaries edged with white on the outer vanes. Length 14 inches; alar expanse $20\frac{1}{2}$ inches. The female is 13 inches long, and is much lighter coloured. In her the black breast and throat are wanting, and generally the black of the dorsal aspect is supplanted by a chesnut or bright ferruginous; the secondaries and scapulars have streaks of cream white on their inner vanes; the rump is waved with grey; the two central tail feathers barred with chesnut, which is imperfectly continued to the outer vanes of the other tail feathers; the feathers of the belly and breast barred black and white, and tipped broadly with white.

Sub genus Lagopus.

Sub gen. char. With the tail round or square, and toes feathered similar to the tarsi.

T. lagopus. White Grouse or Ptarmigan.
Lagopus albus. Baird!

D.C. "Bill weak, compressed towards the point; nails subulate, black and curved; the male constantly with a black band through the eyes; female without the dark ocular band, cicatrice over the eye smaller. Summer plumage.—Above greyish rufous, marked with numerous zigzag lines; on the breast and flanks a great number of black feathers waved with pale rufous; wings, all below the breast, and feet, pure white; the female and young less white; cicatrice over the eye scarlet; weight 24 ounces. Length $14\frac{1}{2}$ inches; alar extent 23 inches."—(Nuttall, page 674).

Genus Columba.

Gen. char. Bill moderate, straight, compressed, rather gibbous towards the tip which is also curved; base of nostrils covered with a soft skin, with an inflated appearance, in which the nostrils are situated, which are medial and longitudinal; feet short,

robust, usually red; tarsi reticulated; toes free, 3 before and 1 behind; tail of 12 to 14 feathers; 2nd primary usually longest.

Sub genus Columba.

Sub gen. char. Legs and feet short and robust; tail square or cuneiform; wings long and acute.

Subdivision II, with the tail long and cuneiform.

C. migratoria. Passenger Pigeon.
Ectopistes migratoria. Baird!

V.S.P. Bill black; nasal protuberance whitish; irides red; legs and feet red; eggs white, two in number, one of them, according to Wilson, usually abortive.

Dorsal aspect. Head, neck, interscapular region, rump, scapulars, great and small wing coverts slate blue; the bluish tint prevailing on the head and rump; on the neck with golden green and purplish reflections; scapulars and great wing coverts with a few long black streaks on the inner vanes of the inner row of scapulars, and on the outer vanes of the outer row of scapulars and the coverts; primaries and secondaries dusky brown, the 2nd, 3rd, 4th, 5th, 6th, 7th and 8th primaries margined with white on their outer vanes; tail coverts bluish slate colour; tail cuneiform, of 12 feathers; the two central feathers brownish black; the two lateral feathers nearly white, the others mostly pale slate colour, with a predominance of white on their inner vanes; near the insertions of all, except the central feathers, on the inner vanes, an oval black spot succeeded by rufous more internally.

Ventral aspect. Cheeks and sides of neck slate blue; chin pale; throat and breast rufous, ("vinaceous"—Nuttall,) with a golden green iridescence; belly and vent paler rufous; wing coverts and flanks white tinged with slate blue; tail coverts white; inner surface of wings slate blue.

2nd primary longest; 1st next; the others graduated. Length including the tail 16½ inches; alar expanse about 22 inches; length of the tail 7½ inches. The female wants the rufous breast, or at most has but a tinge of it in that situation. The young bird, when it arrives in this district, or is bred here, has a deep slate coloured dorsal and ventral aspect, interspersed with soiled white spots. The down, of a dirty yellow colour, may also often be seen above the plumage.

C. Carolinensis. Turtle-dove or Carolina Pigeon.

Zenaidura Carolinensis. Baird!

D.C. Forehead and breast vinaceous; a black spot of it under each ear; tail of 14 feathers, with 4 of the lateral ones black near the extremity and white at the tips; crown and upper part of neck greenish blue; general dorsal colour pale yellowish brown; some of the inner wing coverts spotted with black; below brownish yellow. Length 12 inches; alar extent 17 inches. I saw a specimen of this bird in 1831 which had been shot by some Canadians in the woods on Isle Jesus. It is extremely rare.

Ord. V. Grallatoriæ.

Fam. II. Pressirostres.

Legs long; without a thumb, or the thumb too short to reach the ground; bill moderate.

Genus Charadrius.

Gen. char. Bill shorter than the head, compressed, slender, straight, and rather gibbous towards the tip; nostrils basal, placed horizontally in the membrane which covers the nasal fossa; legs slender, of moderate length; of the three toes projecting forward the exterior is connected to the middle one by a short membrane; the inner toe free; thumb obsolete; tail rounded or square; 1st primary shorter than 2nd which is the longest.

C. pluvialis. Golden Plover.

C. apricarius of Gmelin and Wilson! Adult bird in summer plumage.

C. Virginicus. Baird!

V.S.P. Bill, legs and feet black; irides hazel; eggs 4 to 5 pale olive spotted with black.

Dorsal aspect. Frontlet and space round the eyes greyish white; crown of head, interscapulary region, rump, scapulars, and greater and smaller wing coverts greenish black, the feathers tipped with brown, yellow, yellowish white, or in some instances white; nape of neck grey streaked with dusky; tail coverts white tipped with pale lemon yellow; tail white barred with greenish black; on the two centre feathers the bars assume a serrated appearance, the feathers also tipped with lemon yellow; primaries black, their inner vanes white except towards the tips.

Ventral aspect. Chin, belly, vent, tail and wing coverts white; cheeks, sides of throat, throat, breast, white streaked with dusky.

1st primary longest, the others graduated. Length 10¼ inches; alar expanse 20 inches. In the summer plumage the ventral aspect is black.

C. vociferus. Kildeer Plover.
Aegialitis (Oxyechus) vociferus. Baird!

V.S.P. Bill black; legs and feet yellowish; irides dark hazel; eyelids scarlet; eggs 4, yellowish cream colour, spotted with black.

Dorsal aspect. Frontlet, round the eye, and spot above the auriculars white; front of crown black; remainder of crown, auriculars and dorsal region, including the wing coverts, olive grey; nape of neck forming a part of the collar, white; rump and tail coverts tawny; primaries blackish brown, white on most of of the inner vanes, with a streak of the same colour close to the shafts, on the outer vanes about ⅓ their length; lower row of the greater wing coverts tipped with white; the lateral feathers wholly white, with 5 rudimentary blackish brown bars which are imperfectly carried on to the vanes of the second feather.

Ventral aspect. Streak from the angle of the mouth to the auriculars blackish brown; collar including the chin white; belt on the breast black, intersected by a narrow white streak; all the other parts white including the wing and tail coverts; tail subrotund, the feathers accuminate.

1st primary longest, the others graduated; one of the axillary feathers as long as the 3rd primary. Length 10 inches; alar expanse 19½ inches. A very elegant bird.

C. semipalmatus. Semipalmated Ring Plover.
Tringa hiaticula of Wilson.
Aegialitis semipalmatus. Baird!

V.S.P. Bill orange at base, black towards the tips; legs and feet yellow; irides dark hazel; eggs 4, dark coloured, spotted with black.

Dorsal aspect, Fore part of the crown black, with a crescent of white immediately over the frontlet feathers; a spot below the eye white; streak from nostrils below the eye to the auriculars black; back part of the crown, and the whole dorsal region, including the wing coverts, dark-olive grey; rump and tail coverts paler; the lower row of the great wing coverts tipped with white; primaries brownish black. broadly edged with white on the inner vanes, and extending itself into a streak along the shafts on the

outer vanes of the three or four last; tail olive grey, deepening into brownish black tipped with white; the lateral tail feathers wholly white, and the white tips of the two adjoining very deep.

Ventral aspect. Collar, including the chin, white, but across the breast black; all the other parts white.

1st primary longest, the others graduated; the longest axillary feathers scarcely longer than the 4th primary; feet semipalmated —whence its name. Length 7¼ inches; alar expanse 13½ inches. Tail subsquare.

Genus Vanellus.

Gen. char. Feet 4-toed; thumb short with a nail and reticulated feet.

V. helveticus. Black-bellied or Swiss Plover.
C. apricarius of Wilson!
Charadius helveticus of Brisson!
Vanellus melagonaster of Becstein and Temminck!
Tringa helvetica of Linnæus!
Squatarola helvetica. Baird!

V.S.P. Bill, legs and feet black; irides deep hazel; eggs 4, cream colour, spotted and blotched with light brown and purplish brown.

Dorsal aspect, Frontlet and sides of the crown white; crown and nape of the neck black with brownish white tips to the feathers, giving these parts the latter colour; dorsal region blackish brown broadly tipped with yellowish white; smaller wing coverts olive brown tipped with brownish white; greater wing coverts olive brown tipped with white; rump feathers white barred with brown; primaries blackish brown, a broad streak of white covering one-half of the inner vanes; the middle portion of the shafts white, the white sometimes continued in a streak to the outer vane; axillary feathers brownish black, edged and tipped with soiled white in a serrated manner on the margins; the outer vanes themselves having a worn serrated appearance; tail subsquare; the lateral feathers wholly white; all the others white with 8 or 9 bars of brown.

Ventral aspect. The white border over the auriculars continued down the sides of the neck, terminating broadly under the wings; cheeks, auriculars, chin, throat, breast and belly, and its sides black; vent, flanks, and tail coverts white; femorals also white; 1st primary longest.

1st primary longest; long axillary feathers shorter than the 4th primary, but longer than the 5th. Length 11½ inches; alar expanse 22½ inches.

In its winter plumage this bird has its ventral aspect wholly white; the dorsal aspect blackish brown, varied with greenish yellow fringed with crimson, The young birds have a good deal of white mixed with the black on the ventral aspect.

Fam. II. Cultirostres.

Genus Ardea.

Gen. char. Bill subequal in length to the head, long, compressed and acuminate; upper mandible furrowed slightly; ridge rounded; nostrils lateral, basal, semiclosed by a membrane, and placed in a groove; lores and orbits naked; legs long and slender, a naked space upon the knee; middle and outer toes connected at the base; inner one free; hind toe long; tail of 10 to 12 feathers; 2nd and 3rd primaries longest.

Sub genus Ardea.

Sub gen. char. Bill straight, longer than the head; neck long and slender, and with long pendant feathers from its lower surface; legs long.

A. herodias. Great Heron.
A. herodias. Baird!

D.C. "Bill yellow and black; legs brownish black tinged with yellow, netted with seams of whitish; naked space above the legs brownish yellow; irides orange; eggs 4, greenish blue.

"Dorsal aspect. Space round the eye from the nostril light purplish blue; forehead and middle of the crown white passing over the eye; sides of crown and occiput bluish black, and crested, with two long tapering black feathers 6 inches long; whole upper part of wings, tail and body light ash, the latter ornamented with a profusion of long narrow white feathers, originating on the shoulders and falling gracefully over the wings; primaries dark slate.

"Ventral aspect. Chin, cheeks, sides of head, white; throat white streaked with double rows of black; the rest of the neck brownish, but from the lower part of which proceed narrow pointed white feathers, which spread over the breast nearly to the thighs; under these plumes, the breast, and middle of the belly, are deep blackish slate, the latter streaked with white; flanks

bluish ash; vent white; thighs, and ridges of the wings dark purplish rust colour.

"Bill 8 inches long; $1\frac{1}{4}$ inch wide. Length 4 feet 4 inches; alar extent 6 feet."—(Taken from Nuttall's Ornithology).

Sub genus Botaurus.

Sub gen. char. Bill subequal to head, compressed, deeper than broad; upper mandible sensibly curved; legs and neck comparatively short; naked space above the tibia short; feathers of neck voluntarily erectile.

Section I, with occipital feathers.

A. discors. Night Heron.
A. nycticorax of Wilson!
Nyctiardea gardeni. Baird!

V.S.P. Bill black, tip pale horn colour; legs bluish green; irides red; eggs 4, greenish blue; eyelids purplish blue; lore pale greenish yellow, (bluish white,—Wilson).

Dorsal aspect. Frontlet, and line continued from it over the eye white; crown of head, back, and scapulars jet black with a pea green iridescence; nuchal region ashy white; rump cinereous; tail, secondaries and primaries dark ashy, the latter tinged with bluish slate; the first primary white on the outer vane, the others having a worn appearance; great and small coverts ashy brown; occipital feathers 2 to 3 or 4, long, narrow, white.

Ventral aspect. White, purest on the chin and throat, tinged with ashy on the flanks, and with cream colour on the belly and vent; femorals white.

3rd primary longest; 2nd and 4th subequal; 1st longer than the 4th. Length $24\frac{3}{4}$ inches; alar expanse $34\frac{1}{2}$ inches. Length of the occipital feathers 6 to 8 inches; length of bill from the angle of the mouth to the tip $3\frac{1}{2}$ inches; breadth across the angle of the mouth 1 inch 1 line.

The young bird has a deep brown dorsal aspect, streaked with rufous white, and triangular spots of white on the back and wings; quills ashy, with a terminal spot of white. Ventral aspect. Cinereous streaked with white; irides orange. They want the occipital feathers.

Section II, without the occipital feathers.

A. lentiginosa. American Bittern.
A. minor of Wilson and Buonaparte!
Botaurus lentiginosus. Baird!

V.S.P. Bill yellow at the sides and beneath, blackish brown

above; lores, eyelids, and legs pale greenish yellow; irides orange; eggs 4, cinereous green.

Dorsal aspect. Line over the eye yellowish white; crown ferruginous brown; feathers of nape and sides of neck, large, long, with straggling vanes, ferruginous yellow streaked with brown; below the auriculars a streak of black descends 3 or 4 inches down the neck; dorsal feathers umber brown mottled with black, with cream coloured margins; greater and smaller wing coverts, scapulars, secondaries, rump, and tail brown, sprinkled with brownish yellow and black; the brownish yellow predominating on the great wing coverts; primaries clove brown with pale outer margins.

Ventral aspect. Chin white, with a narrow line of brownish yellow in the medial line; throat cream colour, the feathers with broad central brownish yellow streaks; on the belly and vent the streaks are narrower; flanks brownish yellow, sprinkled with brownish black; tail coverts cream colour; wing coverts cream colour sprinkled with brownish black.

2nd and 3rd primaries subequal in length and longest; 1st about a line shorter. Length 21 inches; alar expanse $31\frac{1}{2}$ inches. The female resembles the male, and the young bird is also similar but has the tints less decided. The legs of the American bittern are long; length of the tarsus 3 inches 2 lines; length of middle toe from the ankle joint to extremity of the nail 3 inches 8 lines; length of bill from the angle of the mouth to the tip $3\frac{1}{2}$ inches.

A. exilis. Little Bittern.
Ardetta exilis. Baird!

v.s.p. Bill yellow with a black ridge; legs and feet yellow tinged with green anteriorly; irides orange yellow; eggs unknown, but if resembling the European analogous species, white.

Dorsal aspect. Frontlet, chesnut deepening into black on the crown of head, which has a deep sea green reflection; sides of head, nape of neck, chesnut; feathers of back and scapulars dark chesnut tipped with rusty yellow; small wing coverts brownish yellow, with a central broad spot of brownish black; upper row of great wing coverts, with the lower row of the smaller ones, rusty yellow; lower row of great wing coverts bright chesnut; rump cinereous, the feathers tipped with whitish; primaries and tail dusky, the former tipped with chesnut.

Ventral aspect. A streak on either side the throat white; chin, remainder of the neck to the breast rusty yellow, with a fine central streak of black in the centre of each feather, internally the neck feathers are white, the rusty yellow confined to the distal halves; on each side of the breast the inner feathers are blackish brown tipped with chesnut; belly and vent white; thighs feathered to the knees.

2nd primary longest; 1st and 3rd subequal, the rest graduated. Length 11½ inches; alar expanse 14½ inches; length of the bill from the angle of the mouth 2 inches 2 lines; length of middle toe 1 inch 6 lines. A very rare bird in this district, only met within the extensive swamps on the southern shore of the St. Lawrence so far as I am aware.

Fam. II. Longirostres.

Genus Scolopax.

Gen. char. Bill longer than the head, more or less curved; thumb too short to assist in walking; 1st and 2nd primaries usually longest with the axillary feathers usually elongated.

Sub genus Calidris.

Sub gen. char. Bill moderately long, slender, straight, soft, flexible, compressed at the base, depressed at the tip, flattened and obtuse; nostrils lateral, and longitudinally cleft; legs slender; toes divided; 1st primary longest.

C. arenaria. Sanderling Plover.
C. rubidus of Wilson!
Charadrius calidris of Gmelin and Brisson!
Tringa arenaria of Linnæus!
Type of genus Arenaria of Bechstein!
Type of genus Calidris of Vigors!
Calidris arenaria. Baird!

V.S.P. Bill, legs and feet black; irides dark hazel; eggs 4, dusky spotted with black.

Dorsal aspect. Frontlet and side of the head white; crown black the feathers tipped with brownish white; nuchal region cinereous with linear darker streaks; dorsal region, scapulars and small wing coverts black, with four whitish spots on each feather; on the back the white spots have a yellow tinge; rump feathers brown faintly tipped with blackish brown; lateral tail coverts white; centre ones brownish tipped with rufous; upper row of

greater wing coverts like the rump; lower row broadly tipped with white; tail subrotund; the two centre feathers blackish brown tipped with yellowish white; the lateral ones more or less tinged with cinereous; primaries black with white shafts.

Ventral aspect. A line from the nostrils to the eye blackish brown; cheeks white, faintly marked with cinereous; chin, sides of throat, and throat, breast, belly, vent, tail and wing coverts, and flanks white; sides of breast faintly tinted with rufous and tipped with cinereous.

1st primary longest, the others graduated; the long scapulary feathers subequal to the 5th primary. Length 8½ inches; alar expanse 14 inches. The winter plumage is the only state in which we meet with this bird in the district. The dorsal aspect, when moulting, is considerably varied with grey.

Sub genus Strepsilas.

Sub gen. char. Bill moderate, hard at the point, strong, straight, slightly elevated at the tip, with a flattened ridge and truncated tip; nostrils basal, lateral, semiclosed by a membrane; feet 4-toed; the thumb barely reaching the ground; the anterior toes connected at the base; 1st primary longest.

S. interpres. The Turnstone.
S. collaris of Temminck!
Tringa interpres of Wilson!
Tringa monnilla of Linnæus! young of 1st year.
Strepsilas interpres. Baird!

V.S.P. Bill black; legs orange yellow; irides hazel; eggs 4, olive green spotted with brown.

Dorsal aspect. A line from the ridge of the bill to above the eyes including the frontlet, a line from the angle of the mouth to the collar, the auriculars all black; an orbicular spot in front of the eye, another below the auriculars, and a third below the collar, white; crown and nape of neck streaked with black bordered on the sides with white; feathers of the back, scapulars, and coverts varied with chesnut, black, with occasional white tips to the feathers; rump white; upper row of tail coverts black; lower row white; lateral tail feathers white, with a spot of blackish brown on the inner vanes; bases of all the others white, changing to blackish brown and tipped with white; primaries blackish brown, white on the inner vanes near their insertions; shafts white.

Ventral aspect. Chin and throat white; breast, sides of the breast, with the collar black; all the rest white.

1st primary longest, the rest graduated; long scapulary feather subequal to the 3rd primary; tail square. Length $9\frac{1}{2}$ inches; alar expanse 17 inches. The young of the 1st year have no traces either of black or chesnut, but a cinereous brown assumes its place; the feathers of the back have yellowish tips; the feet are yellowish red.

Sub genus Numenius.

Sub gen. char. Bill long, slender, compressed at base, depressed at the tip, furrowed for half the length and curved; nostrils in the furrow of the upper mandible, basal, and lateral; legs long, moderately stout; toes short compared to the leg; thumb barely reaching the ground; front toes connected at the base; 1st primary longest.

N. longirostris. Long-billed Curlew.
N. (Numenius) longirostris. Baird!

D. C. Bill 7 inches long, brownish black, purplish flesh colour below towards the base; legs and feet greyish blue or lead colour; irides dark hazel; eggs 4, cream coloured spotted brown?

Dorsal aspect. Blackish brown, spotted and interruptedly barred with different shades of rufous; line round the eye brownish white; primaries brownish black on the outer edges, pale rufous on the inner and barred with black; shafts of the 1st primary white; the rest of the wing pale reddish brown, with waving linear bars of dusky; axillaries plain with a few remote dusky marginal streaks; tail rounded, pale rufous, with about 10 dusky brown bars; crown blackish with whitish streaks and no medial line.

Ventral aspect. Chin, brownish white; neck pale, whitish buff, streaked with black; belly, thighs, and vent pale rufous white without spots; wing linings salmon rufous sparingly dotted with blackish.

Length about 25 inches; alar expanse 39 inches; weight about 30 ounces. (Compiled from Nuttall.)

N. Hudsonicus. Esquimaux Curlew.
Scolopax borealis of Wilson!
N. (Phaeopus) Hudsonicus. Baird!

V.S.P. Bill black, purplish towards the base of the under mandible; legs and feet dark lead colour; irides hazel; eggs 4, dark bluish grey spotted with black or dark brown.

Dorsal aspect. Crown of head dark brown with a medial line of greyish white; an oval spot between the eye and nostrils, and line over the eye white; a streak of dark grey between the angle of the mouth and the eye; cheeks, sides of the neck, and nape greyish white with brown streaks; whole dorsal region, including the axillaries, wing and tail coverts, and rump, pale dusky brown, with an occasional violet iridescence, the edges of the feathers having a worn appearance, the outer vanes of the axillaries especially having a serrated and worn appearance; tail square, dusky brown inclining to a rufous tinge at the base, barred with blackish brown. The shaft of the 1st primary white, that of the next pale brown, all the others deep brown; the quills brownish black barred with greyish white on the inner vanes, and on the outer vanes of all except the three first primaries; the long axillaries not barred.

Ventral aspect. Chin, belly and vent white; throat and breast greyish white streaked with dusky which is darkest on the throat; flank and lateral tail feathers rufous white, barred with dusky brown; wing linings salmon colour barred with dusky brown; centre tail feathers white.

1st primary longest; long scapulary feathers equal to the 5th primary; length of the bill 3½ inches; length of the bird 17¼ inches; alar expanse 28½ inches.

N. borealis. Small Esquimaux Curlew.
N. brevirostris of Temminck!
Scolopax borealis of Forster!
N. (*Phacopus*) *borealis.* Baird!

V.S.P. Bill slender, brownish black; legs and feet olive black; irides hazel; eggs 4, spotted with light umber brown.

Dorsal aspect. Blackish with a medial line of greyish white; sides of crown brownish white; streak from the nostrils brown, prolonged behind the eye to above the auriculars; nape and sides of neck brownish, with streaks of a darker tint; interscapulary region, scapulars, long axillary feathers, greater and smaller wing coverts blackish brown, with rufous white marginal spots of a triangular shape; tail coverts and tail rufous white, barred with blackish brown; belly and vent rufous white.

Ventral aspect. Chin white; throat and breast, with the sides of the latter rufous white, streaked with blackish brown, and barred with a V shaped spot of the same colour on the breast;

flank feathers rufous white barred with brown; lateral tail coverts rufous white barred with brown on the outer vanes of the lateral ones; wing linings salmon colour barred with blackish brown; belly and vent rufous white.

1st primary longest; long axillary feathers longer than the 5th but shorter than the 4th; all the primaries except the 1st and 2nd tipped with white. Length 14 inches; alar expanse 25 inches; length of the bill 2¼ inches. In the female the medial line on the crown is obsolete.

Sub genus Scolopax.

Sub gen. char. Bill slender, long, compressed, soft, straight, with a turned tip, the tip of the upper mandible projecting over the lower and tuberculated; both mandibles furrowed for half their length; nostrils lateral, basal, linear, in the furrow of the mandible, and covered by a membrane; feet not palmated; the orbits placed far back on the head. In some species the external and middle toes are connected to the first joint.

S. grisea. Red-breasted Snipe.
S. noveboracensis of Latham and Gmelin!!
Macroramphus griseus of Leach!
Macrorhamphus griseus. Baird!

V S.P. Bill black towards the tip, the remainder dull olive; legs and feet bluish grey; irides hazel; eggs unknown.

Dorsal aspect. Crown blackish brown tipped with brownish chesnut; sides of the head commencing at the nostrils greyish white; a streak from the angle of the mouth to the eye, and another more faint beyond it greyish brown; cheeks greyish white; nuchal region grey; interscapulary region, scapulars, long axillary feathers blackish brown, tipped and striped on the margins with chesnut; small wing coverts and great wing coverts, dusky, the former tipped with grey, the latter with pale chesnut; rump, tail coverts and tail, white barred with blackish brown, the latter also tipped with pale chesnut; primaries brownish black.

Ventral aspect. Chin and throat greyish white; breast rufous with imperfect and irregular streaks of brown; flanks rufous white with faint wavy lines of brown; internal linings white with blackish brown bars; tail coverts rufous white with bars; belly and vent white tinted with rufous.

1st primary longest; 2nd considerably longer than the 3rd; long scapulary feathers longer than the 4th primary but shorter

than the 3rd. Length $10\frac{3}{4}$ inches; alar expanse $16\frac{1}{2}$ inches; length of bill $2\frac{1}{3}$ inches. The shaft of the first primary is white, that of all the others pale brown.

S. Wilsonii. Common or Wilson's Snipe.
S. gallinago of Wilson!
Gallinago Wilsonii. Baird!

V.S.P. Bill black at the tip, the rest brown; legs and feet grey; irides hazel; eggs 4, olivaceous spotted with brown.

Dorsal aspect. Crown of head black, separated in two by a medial line of white; line from the ridge of the bill over the eye brownish white; and another from the nostrils to the eye blackish brown; the auriculars and cheeks greyish white, the former margined with brown; nuchal region ferruginous streaked with blackish brown; dorsal region and scapulars black, the latter edged with cream colour on the outer vanes, and spotted with chesnut on both; scapulary feathers edged with white on the outer vanes, spotted and barred with chesnut; great and small wing coverts dusky tipped with greyish white; rump and tail coverts brownish black barred with rufous brown, the bars caused by spots on the vanes of the feathers; tail rounded, jet black, with a subterminal band of bright chesnut succeeded by a narrow black border, and lastly tipped with rufous white; primaries dusky, the outer vane of the first white, and the outer vane of the second margined with white, all of them faintly tipped with white.

Ventral aspect. Chin white; throat and breast brownish white spotted with brown; belly and vent white; flanks white elegantly barred with brownish black; tail coverts rufous barred with brown.

1st primary longest; 2nd subequal to it; long scapulary feathers subequal to the 3rd primary. Length 11 inches; alar expanse $16\frac{1}{2}$ inches; length of the bill $2\frac{1}{3}$ inches. The two lateral tail feathers of this bird are wholly white, with 7 equidistant blackish bars; these bars are imperfectly continued to the next ones, becoming less in number until we arrive at the centre ones where they are obsolete; the chesnut band commences at the third, and deepens in tint as it approaches the central feathers.

S. minor. Woodcock.
Rusticola minor of Nuttall!
Philohela minor. Baird!

V.S.P. Bill bluish black tinged with orange towards the base; legs and feet pale orange; irides dark hazel; eggs 4, olivaceous white blotched with yellowish brown.

Dorsal aspect. Frontlet and crown as far as the centre of the head cinereous tinted with pale rufous; occiput and nuchal region black with three transversal narrow bands of rufous, the lowest one tinged with cinereous, the remainder of the nuchal region cinereous; a line from the angle of the mouth to the eye black; cheeks and auriculars cinereous white, with irregular narrow wavy lines of black; dorsal feathers and scapulars black barred and tipped with bright chesnut; the outer vanes of the outermost row of both wholly cinereous, thus causing four broad streaks of cinereous down the back; great and small wing coverts with the secondaries dusky, barred with wavy zigzag lines of blackish brown, cinereous, and pale chesnut; primaries dusky, the outer vanes of the 1st, 2nd, 3rd, and 4th edged with whitish; rump black barred with bright chesnut in an irregular manner, and tipped with cinereous; central tail coverts black tipped with chesnut; the lateral ones bright chesnut with wavy lines of black; tail round, jet black, with a subterminal narrow band of chesnut, and broadly tipped with cinereous; all the primaries tipped with white.

Ventral aspect. Chin white; throat, sides of the throat, breast, belly, vent and flanks rufous, tinted with cinereous on the sides of the throat, pale on the belly and vent, and very bright on the flanks; tail coverts bright rufous, the lateral feathers tipped with white; tail jet black, with a broad terminal band of glossy white corresponding with the cinereous tip of the dorsal aspect.

3rd primary longest; 4th next; 1st and 8th equal; the longest scapulars subequal to the 3rd primary; from the comparative length of the primaries the wing is very much rounded. Length $12\frac{3}{4}$ inches; alar expanse 17 inches; length of bill $2\frac{3}{8}$ inches. This bird though considerably smaller than the European bird, has its bill of exactly equal dimensions.

Sub genus Limosa.

Sub gen. char. Bill longer than in the last sub-genus, straight, more or less incurved from the centre, soft and flexible; the nasal

furrows extend nearly the whole length; nostrils basal, lateral, linear and pervious; middle and external toes connected at the base; thumb short and slender, scarcely touching the ground.

L. fedoa. Great Marbled Godwit.
Scolopax fedoa of Wilson!
Limosa fedoa. Baird!

D.C. Bill incurved; rump uniform in colour with the rest of the plumage; tail brownish banded with black. Summer plumage dusky brown varied with rufous, beneath pale ferruginous; winter dress cinereous, beneath whitish; male with the breast marked with undulating bars of dusky brown. This bird is very rarely met with in this district; an occasional straggler however has been seen as I have been informed.

L. Hudsonica. Hudsonian Godwit.
Scolopax Hudsonica of Latham! and Pennant!
Limosa Hudsonica. Baird!

V.S.P. Ridge and tip of bill brown, the rest purplish flesh colour; legs and feet black; irides dark hazel; eggs 4, dark olive spotted with pale brown.

Dorsal aspect. Crown of head and occiput spotted wood brown and greyish white; line from the nostrils over the eye, white with faint spots; another from above the angle of the mouth to the eye woody brown; neck, interscapulary region, and scapulars blackish brown with spots of rusty white; the long scapulars with ragged outer vanes and spotted with brownish white; rump white; tail white at the base, terminating iu a deep blackish brown and tipped with white; great and small wing coverts dusky, with pale ragged edgings; the lower row of the great coverts edged with white; primaries clove brown, the shafts white to near the tips, and inclining to white on the inner vanes.

Ventral aspect. Chin white; cheeks white spotted with wood brown; neck, breast and belly ferruginous, the feathers with a subterminal band of blackish brown, generally zigzag, and tipped with white flank feathers, barred with blackish brown; tail coverts with their basal halves white, their distal halves ferruginous and elegantly barred with blackish brown; the lateral coverts paler than the central ones.

1st primary longest; the others graduated; longest scapular subequal to the 4th primary. Length $15\frac{3}{4}$ inches; alar expanse 25 inches; length of the bill 3 inches.

A young bird in the Museum of the Natural History Society, has its dorsal aspect, with the exception of the transversal band of the rump, which is white, dusky, barred with brown on the dorsal region and short scapulars; the long scapulars and quills clove brown, the latter tipped with white, the former with a few terminal bands of pale ferruginous; on the ventral aspect, the chin and cheeks are white; throat and breast dusky; belly, vent and flanks, with the tail coverts dusky white, the last with a streak of brown in the centre of each feather and margined with dusky; the line from the bill to the eye like the old bird. This bird is a rare one in the district of Montreal, and appears to associate with the curlews.

Sub genus Phaleropus.

Sub gen. char. Bill a little longer than the head, slender, straight, depressed at the base, furrowed on both mandibles to near the tip; tip of upper mandible inflected on the lower, and rather subulate; nostrils linear, lateral and basal; front toes connected at base by a membrane, the inner toe to the first joint, the outer toe to the second joint; the membranous margin of the remainder of the toes broadly and deeply scolloped; hind toe short, scarcely touching the ground, and consequently scarcely used in walking.

P. hyperboreus. Hyperborean Phalerope.
P. fuscus of Latham!
Lobipes hyperboreus of Cuvier!
Tringa hyperborea of Linnæus!
Tringa lobata, young of do.!
Phaleropus hyperboreus. Baird!

V.S.P. Bill black; legs and feet blackish greeen; irides hazel; eggs 3 to 4, olivaceous, thickly spotted with blackish brown.

Young bird; dorsal aspect. Frontlet, line over the eye, and between the auriculars, and nuchal region white; spot in front of the eye, auriculars, and crown of head blackish brown, descending in a streak along the centre of the nape of the neck; the remainder of the nape of neck white tinged with cinereous; interscapulary region and scapulars blackish brown edged with tawny; rump blackish brown, the feathers tipped with white; lateral tail coverts white, central ones blackish brown tipped with tawny; tail blackish brown, the centre feathers tipped with tawny, the lateral feathers edged and tipped with white; small

wing coverts plain blackish brown ; upper and lower row of great wing coverts blackish brown tipped with white; quills blackish with white shafts, and edged with white on the inner vanes.

Ventral aspect. White, except on the sides of the breast and flanks, where the white is tinted with cinereous.

"The old male is black varied rufous; beneath white; sides of neck and breast bright rufous and ash; sides and front of neck bright brownish orange."

1st primary longest; the others graduated; long scapulars subequal to the 3rd primary. Length 7¾ inches; alar expanse 13 inches; length of bill 1 inch scarcely. I have never seen the old bird in its nuptial dress. The young birds however are not uncommon, and when they are met with the young and old resemble one another in their leading features.

Sub genus Tringa.

Sub gen. char. Bill of medium size, as long as, or a little longer than the head, rather curved, flexible, subcylindrical, compressed at the base, with a smooth tip, and with both mandibles furrowed to near the tip; nostrils situated in the furrows, basal, lateral and linear, covered by a membrane; feet 4-toed, tarsus slender; hind toe barely touching the ground.

T. alpina. The Dunlin or Ox Bird.
T. variabilis of Temminck!
T. cinclus of Linnæus!
Tringa (Shoeniclus) alpina, var. Americana. Baird!

V.S.P. Bill blackish; legs and feet blackish brown; irides hazel; eggs 4, oil green spotted liver brown.

Dorsal aspect. Frontlet, line over the eye, cheeks, and nape of neck white, with irregular blackish brown streaks; crown and occiput black, the feathers edged broadly with ferruginous; dorsal region, rump, and short scapulars black, with very broad ferruginous margins, almost chesnut, and tipped with white; the short scapulars with a subterminal band of blackish brown; long scapulars, and small wing coverts dusky; great wing coverts dusky tipped with white; central tail coverts black broadly edged with ferruginous; lateral ones wholly white; quills dusky with white shafts and white inner vanes; the 5th, 6th, 7th, 8th, and 9th with a touch of white on the centre of the margin of the outer vanes; tail dusky, the lateral tail feathers nearly altogether white.

Ventral aspect. Chin white; throat and breast cinereous white streaked with blackish brown; flanks, tail coverts and vent white with blackish brown streaks in the centre of the feathers; belly black, wi h white edgings to the feathers.

1st primary longest; the others graduated; the long scapulars which have a ragged appearance, longer than the 5th but shorter than the 4th primary. Length 9 inches; alar expanse 14 inches; length of the bill $1\frac{1}{2}$ inch. Described from a male in its nuptial dress.

T. pectoralis. Pectoral Sandpiper.
Pelidna pectoralis of Say!

V.S.P. Bill black at the tip, reddish yellow at the base; legs and feet olivaceo is; irides dark hazel, almost black; eggs unknown.

Dorsal aspect. Crown of head, interscapulary region, and rump black, with ferruginous tips and edgings; nape of neck dusky streaked with brown; scapulars black margined with ferruginous and tipped with white on the outer vanes only; long scapulars black edged with ferruginous on both vanes; great and small wing coverts dusky, the latter tipped with pale ferruginous, the former. with ferruginous on both vanes, except the extremity of the outer vane where it changes to white; tail with the lateral feathers dusky tipped with brownish white; the centre feathers jet black margined with ferruginous; lateral tail coverts white spotted with blackish on the outer vanes; quills plain clove brown; shaft of 1st primary white; the shafts of all the others brown; streak from the nostrils to and around the eye white; another from the rictus to the eye umber brown.

Ventral aspect. Chin white; cheeks, sides of throat, throat and breast brownish white with dusky streaks; flanks, axillaries, vent and tail coverts white.

1st primary longest; the others graduated; long scapulars shorter than the 4th, longer than the 5th. Length $8\frac{1}{2}$ inches; alar expanse 13 inches; length of bill about 1 inch and about a line; length of tarsus 1 inch; length of middle toe with the nail 1 inch, 1 line. The winter dress of this bird is cinereous brown with a white ventral aspect.

T. rufescens. Buff-breasted Sandpiper.
Tringites rufescens. Baird!

D.C. "Bill blackish, scarcely the length of the head, nearly

straight, below pale ferruginous; inner webs of the primaries mottled; rump blackish; legs and feet brown; tarsus 15 lines long. Summer plumage varied with black and brownish rufous; beneath rufous much paler on the abdomen. Winter dress unknown."—(Nuttall). From the geographical range of this species I have no doubt but that it visits this District, although I have not hitherto met with a specimen of it.

T. Pusilla. Little Sandpiper.
T. Temminckii of Leisler.
Tringa Wilsonii. Baird?

V.S.P. Upper mandible blackish; lower one orange at the base, black at the tip; bill shorter than the head; legs and feet brownish; irides hazel; eggs unknown.

Dorsal aspect. Line from the nostrils over and beyond the eye cinereous white; crown and interscapulary region black broadly edged and tipped with ferruginous; nuchal region cinereous; rump, scapulars blackish brown, edged with ferruginous on both vanes, except at the tip of the outer vane which is white; small and great wing coverts dusky tipped with ferruginous; lower row of great wing coverts tipped with white; central tail coverts black; lateral ones white; tail rounded, the two central feathers blackish brown, tipped with ferruginous white; lateral ones cinereous deepening in tint from the sides over to the center ones; quills plain clove brown with white shafts.

Ventral aspect. Cheeks, breast, and sides of the breast cinereous with dusky streaks; chin and remainder of the ventral aspect pure white.

1st primary longest; the others graduated; long scapulars longer than the 4th but shorter than the 3rd primary. Length 6 inches; alar expanse $10\frac{1}{2}$ inches; length of bill $\frac{2}{3}$ inch. The *Tringa minuta* and *Tringa Wilsonii*, from their geographical range, may visit us, but I cannot state so with certainty, having never met with either species.

T. rufa. Red-breasted Sandpiper.
T. cinerea. Winter plumage. Linnæus and Wilson!!
T. canuta, islandica, cinerea, australis, nævia, grisea of Gmelin!
Macrorhamphus griseus. Baird!

V.S.P. Bill, legs and feet blackish; irides hazel; eggs 4 dun colour spotted red.

Dorsal aspect. Crown, interscapulary region and rump, blackish brown margined with greyish white, which is tinted with rufous on the crown and back; nape of neck cinereous streaked with blackish brown; short scapulars blackish brown edged with pale rufous, and a couple of subterminal spots of the same colour, and tipped with cinereous; long scapulars plain dusky; great and small wing coverts dusky, the lower row of the former broadly tipped with white, and all of them with pale edgings; tail coverts white elegantly barred with blackish brown; tail square, cinereous; primaries clove brown, white on the internal vanes towards the base, with white shafts, and edged with white towards the centre of the outer vanes of all except the first and second.

Ventral aspect. Line from the angle of the mouth to the eye blackish brown; auriculars blackish brown; line from the nostrils to, over, and beyond the eye above the auriculars, pale rufous; throat, breast and sides pale rufous, with faint bars of blackish brown in the latter situation; belly and vent white tinged with rufous; flanks white with zigzag bars of blackish brown; tail coverts white with a subterminal triangular spot of blackish brown; axillaries cinereous with a terminal band of a deeper tint and tipped with white.

1st primary longest; long scapulars longer than the 4th, and shorter than the 5th; the bill is straight, flattened, and rather spoon-shaped at the tip; tip of the upper inflected over the lower and $1\frac{1}{3}$ inch long; legs of moderate size, stout; toes free, margins serrated. Length $10\frac{1}{2}$ inches; alar expanse 21 inches. The above description is taken from a specimen which is moulting from its summer to its winter plumage. Another in its complete winter dress lies beside me, constituting the *T. cinerea* of Wilson. The whole dorsal aspect, including the long scapulars and tail, is cinereous tipped with cinereous white; the lower row of great wing coverts tipped with white; tail coverts white barred with cinereous, and the ventral aspect is white tinged with rufous very dilutely, with specks of dusky on the throat breast, cheeks and sides. The rictu-orbital streak brownish black, and the streak from the nostrils to, over, and beyond the eye, above the auriculars, white. Perhaps there is not a bird whose varieties of plumage in its different ages and states, have caused it to be described under so many different names.

T. semipalmata. Semipalmated Sandpiper.
Ereunetes petrificatus. Baird!

D.C. "Bill shorter than the head, straight, somewhat depressed and enlarged towards the point; rump blackish; middle tail feathers longest. Summer plumage varied with blackish, olive grey, and pale rufous; beneath, except the breast white. Winter dress dark cinereous, beneath principally white; feet semipalmate."—(Nuttall).

Sub genus Totanus.

Sub gen. char. Bill moderate, slender, straight, furrowed to near the middle, compressed, acute, slightly curved at the point; nostrils basal, lateral, linear; inner toe cleft, outer toe connected to the middle as far as the first, sometimes to the second joint; thumb short, slender, barely touching the ground.

T. vociferus. Greater Yellow-shanks.
T. melanoleucas of Viellot and Buonaparte!
Scolopax vociferus of Wilson!
Gambetta melanoleuca. Baird!

V.S.P. Bill black changing to yellow at the base; legs and feet yellow; irides hazel; eggs uncertain or unknown.

Dorsal aspect. Line from the nostrils to, and circumventing the eye white; crown of head brown, margined with white; neck cinereous with brown streaks; interscapulary region, and rump cinereous, margined and occasionally spotted with white; great and small wing coverts, long and short scapulars cinereous, changing to glossy brown on the long scapulars, with marginal triangular spots of white on both outer and inner vanes; tail coverts white wth zigzag bars of brown; tail brown barred with white; quills plain clove brown; the shaft of the first primary white.

Ventral aspect. Chin, belly, vent, central tail coverts, white; throat streaked with brown; sides of the breast brown, with a terminal spot of white on each vane near the tip; flank feathers, axillaries, and lateral tail coverts pure white, with irregular distant zigzag bars of brown; lower surface of the quills hoary.

1st primary longest; long scapulars subequal to the 5th primary. Length 14½ inches; alar expanse 22 inches; length of bill 2⅓ inches; length of the tarsus 2⅓ inches; length of middle toe 1½ inch.

T. flavipes. Yellow-shank Tatler.
Scolopax flavipes of Wilson!
Gambetta flavipes. Baird!

V.S.P. Bill blackish; legs and feet yellow; irides hazel; eggs unknown.

Dorsal aspect. Line from the base of the bill to the eye white; another from the nostrils to the eye, brown; crown of head brown edged with white; nuchal region dark cinereous, faintly streaked with white; interscapulary region, long and short scapulars, great and small wing coverts glossy brown, with triangular marginal spots of white, which are tinted with brown on the back; rump white; tail coverts white barred with brown; tail square, white barred with cinereous brown; the two or four central feathers deepest in colour; the lateral ones pale irregularly barred; the side feathers wholly white on the inner vanes, and mottled on the outer; quills clove brown, from the 5th downwards tipped with white.

Ventral aspect. Chin, belly, vent, and central tail coverts pure white; auriculars brown; cheeks, throat, sides of the breast and sides cinereous, the feathers tipped with ashy white and white; flank feathers white, irregularly spotted with cinereous; lateral, tail feathers, and axillaries white, barred with cinereous brown.

1st primary longest; long scapulars subequal to the 5th primary, and longer than the 6th. Length $9\frac{1}{2}$ inches; alar expanse 18 inches; length of bill $1\frac{1}{2}$ inch; length of tarsus 1 inch and about 10 lines to 2 inches.

T. chloropygius. Green-rump Tatler.
Tringa solitaria of Wilson!
Rhyacophilus solitarius. Baird!

V.S.P. Bill black; legs and feet olivaceous brown; irides dark hazel; eggs unknown.

Dorsal aspect. Line from the base of the bill over the eye, white; rictu-orbital line brown; crown of head and nuchal region deep brown, the feathers faintly tipped with white; interscapulary region, long and short scapulars, and great wing coverts glossy olive brown, with a deep sea green iridescence; small wing coverts and rump, plain glossy olive brown; middle tail coverts and middle tail feathers olive brown, with faint marginal white

spots; lateral tail coverts and tail feathers white, elegantly barred with blackish brown; primary quills dark blackish brown, with brown shafts.

Ventral aspect. Chin, belly, flanks, and lateral tail coverts with the vent pure white; throat and middle of the breast white, streaked with brown; sides of breast and sides barred with brown, very thickly so in the former place; axillaries white, barred with brown; central tail coverts white with a deep subterminal bar of brown.

1st primary longest; the others graduated; long scapulars equal to the 5th primary. Length 9 inches; alar expanse 15 inches; length of bill from the angle of the mouth $1\frac{1}{8}$ inch; length of the tarsus equal to the bill, viz., $1\frac{1}{8}$ inch.

T. macularius. Sandlark or Spotted Tatler.
Tringa maculata of Edwards!
Tringa (Actodromas) maculata. Baird!

D.C. This bird although exceedingly common, I am unable at present to describe from a specimen, as I cannot obtain one. The following however is from Nuttal:

Glossy olive brown waved with dusky; rump and tail of the same colour as the rest of the plumage; one or more outer tail feathers white barred with black; quills dark olive brown with a large spot of white on the inner web. Adult beneath white with roundish dusky spots; bill yellow below, black towards the tip. Young, beneath white; wing coverts edged but not barred with waving dusky lines; upper mandible blackish.

I have never met the T. Bartramii in this district.

Fam. V. Macrodactyli.

Genus Rallus.

Gen. char. Bill longer or shorter than the head, thick at base, becoming suddenly compressed, grooved for the half length of the upper mandible, curved at the extremity, and the base projecting on the forehead; nostrils in the furrow basal, lateral, more or less linear; toes four; thumb long, not longer than a single joint of the middle toe; wings rounded; 2nd, 3rd, and 4th primaries longest, the flight consequently feeble; tail of 12 feathers, not longer than the coverts.

Subdivision 1st. Bill longer than the head, curved, nostrils linear.

R. Virginianus. Lesser Clapper Rail.
R. Virginianus. Baird!

v.s.p. Bill brown on the ridge, yellow on the lower mandible; legs and feet dusky reddish brown; irides red; eggs 6 to 10, cream colour sprinkled with brownish red and pale purple.

Dorsal aspect. Line from nostrils to the eye, and a spot below the eye white; in front of the eye to the angle of the mouth, a subtriangular black space having the orbits for its base, shaded to slate colour on the sides of the crown, cheeks, auriculars, and sides of neck; crown blackish slate colour; neck, interscapulary region, scapulars, rump and tail coverts, deep blackish brown, with olivaceous brown edgings; great and small wing coverts chesnut; primaries plain dusky; tail short, rounded, and in colour like the primaries.

Ventral aspect. Chin white; sides of the chin, throat, breast, and belly ferruginous; on the sides of the breast tinged with olivaceous, brightest in tint on the breast, and paler on the centre of the belly; flanks and vent black, with irregular whitish bars; tail coverts blackish brown, with a subterminal band of white, tipped with dilute ferruginous.

2nd and 3rd primaries subequal and longest; 1st equal to the 5th; long scapulars equal to the 5th. Length 9½ inches; alar expanse 12½ inches; length of bill 1½ inch.

Subdivision 2. Bill shorter than the head, robust, acute at point; nostrils oblong.

R. Carolinus. Carolina Rail.
Gallinula Carolina of Latham!
Gallinula minor of Edwards!
Porzana (Porzona) Carolina. Baird!

v.s.p. Bill yellow with a blackish tip; legs and feet yellowish green; irides reddish hazel; eggs uncertain.

Dorsal aspect. Frontlet, space in front of the eye, and centre of the crown blaek; line over the eye and cheeks ashy; auriculars pale olive; sides of the crown and nuchal region olive; interscapulary region and scapulars olive, with a central streak of blackish brown, and edged with white on the outer vanes; the long scapulars with white on the inner vanes above rump, black, tipped broadly with olive; great and small wing coverts plain olive; tail coverts blackish brown edged with olive, a few of the

central ones with white margins; tail cuneiform broadly edged with olive; outer edge of the 1st primary white; outer vanes of the 2nd speckled with white about its centre; all the rest of the quills olive brown.

Ventral aspect. Chin, and line down the throat black; sides of throat, commencing from the cheeks ashy; breast ashy barred with white; sides, and flanks olive barred with ash white; vent and centre of the belly white; tail coverts white, the central ones tinted with yellow.

2nd primary longest; long scapulars equal to the 4th primary; Length $7\frac{1}{4}$ inches; alar expanse $11\frac{1}{2}$ inches; length of bill $\frac{3}{4}$ inch; length of tarsus and middle toe together 3 inches.

R. Noveboracensis. Yellow-breasted Rail.
Gallinula Noveboracensis of Latham!
Fulica Noveboracensis of Gmelin!
Perdix Hudsonica of Idem!
Rallus ruficollis of Viellot!
Porzana (*Columnicops*) *Hoveboracensis.* Baird!

V.S.P. Bill dusky brown, greenish yellow at the base, and for a short distance on the ridge; legs and feet dusky flesh colour; irides hazel; eggs 10 to 16, white, (according to Richardson.)

Dorsal aspect. Frontlet, line over the eye and sides of the neck yellowish brown, faintly barred with dark brown; crown of head, and nape of neck black, with minute white tips to the feathers; interscapulary region, and scapulars, rump, great and small wing, and tail coverts black, with one to two narrow white bars on the feathers, and broadly margined, especially on the scapulars, with yellowish brown: tail cuneiform, short, black, with irregular, scarcely conspicuous, bars of white, not more than three in number; quills dusky, with a subterminal faint bar of white; auriculars brown, with a minute subterminal bar of white.

Ventral aspect. Chin yellowish white; throat, breast, and sides brown internally, the remaining half of the feathers, first faintly white, succeeded by yellowish brown, and tipped with brown, giving these parts a wavy appearance of brown, yellowish brown, and faint white; belly white; flanks and vent black, with a couple of narrow bars of white; tail coverts black with a subterminal narrow bar of white, succeeded by brown and tipped with white.

1st and 2nd primaries subequal and longest; the long scapulars subequal to the 3rd primary. Length $6\frac{2}{3}$ inches; alar expanse 10 inches; length of bill $\frac{2}{3}$ inch; length of middle toe and tarsus 2 inches and 1 line. This rail is very scarce indeed, having been only met with in the extensive swamps on the southern shore of the St. Lawrence in the neighborhood of Sorel.

Genus Fulica.

Gen. char. Bill shorter than the head, strong, conical, compressed, deeper than broad at the base; mandibles furrowed on each side at the base, equal; upper mandible projecting over the lower at the sides, and its base spreading on the forehead; lower mandible navicular; nostrils lateral, longitudinally cleft, semiclosed; all the toes connected at the bases with a scolloped membrane; 2nd and 3rd primaries longest.

F. Americana. Common Coot.
F. atra of Wilson!
Fulica Americana. Baird!

V.S.P. Bill yellowish at the base, succeeded beyond the nostrils by a chesnut ring, tipped horn colour; frontal callosity white, with a rhomboidal chesnut coloured spot; irides red; legs and feet yellowish green; eggs uncertain.

Dorsal aspect. Crown of the head, cheeks, nuchal region, slaty black; interscapulary region and scapulars slaty black, tinged with olive; tail coverts olive black, great and small wing coverts and tail slate colour; primaries dusky, the outer vane of the first primary edged with white, and the secondaries which are slate, tipped with white.

Ventral aspect. Chin and throat black; breast pale slate with faint tips of slaty white to the feathers; belly and vent pale slate colour, the whitish bars more numerous, but irregular, thus giving this part a whiter appearance; flank feathers slate tinged with olive; tail coverts white.

2nd primary longest, 1 and 4 equal; long scapulars equal to the 2nd primary; length $16\frac{1}{2}$ inches; alar expanse 27 inches; length of tarsus 2 inches; length of middle toe to the heel including the nail $3\frac{1}{2}$ inches.

(*To be continued.*)

ARTICLE XXXIV.—*On the Cattskill Group of New York. By* Prof. JAMES HALL. *A Letter addressed to Principal Dawson, dated Albany, October*, 1862.

Having furnished you with a considerable number of specimens of Devonian fossil plants, from the State collections, and from my own cabinet, for study and description, I have felt not only great interest in the matter, but much solicitude in regard to the geological position of some of them; and this feeling has been increased by studying your list of specimens with reference to the geological formations, for it seemed to me that there were some results not quite in accordance with palæontological laws, and that there was reason to question the geological order assigned to the specimens.

A considerable number of these had been collected by myself or under my immediate direction many years since, and of these I feel secure; but there were others which, though obtained from authenticated localities of the *Cattskill group*, had not been collected by myself; and in regard to some of these and some of the others not of my own collecting, I believe I expressed doubts, though the greater proportion were reliable.

Late investigations, combined with those heretofore made, have forced upon me the conviction that the greater part of the area colored on the geological map of New York as *Cattskill group*, is in fact occupied by the Portage and Chemung groups.

Several years since, in making sections across the country from north to south, and through the counties of Albany and Schoharie, I ascertained that the Hamilton group, as indicated by its well marked and characteristic fossils, extends to the southern limit of the coloring indicating Chemung group, on the geological map, I am now prepared to show that the Hamilton group in the counties of Albany, Greene, Schoharie, Otsego, and a part of Chenango, with the exception of some outliers on the higher hills, occupies nearly the entire belt colored as Chemung, the southern line corresponding very nearly with the limit assigned to that formation; thus leaving the Chemung group with its southern limits still unassigned.

The investigation of the extent and limitation of this group has been beset with difficulties, both towards the west and east of the typical region in southern central New York. In tracing to the eastward the strata of the Chemung group, we find them gra-

dually assuming a coarser character, attended by a diminution of the number of fossils, both of individuals and of species. With the accession of coarse materials comes diagonal lamination, and abrupt changes in the nature of the sediment, with other attendant features indicating a deposit of littoral character.

Until within a few years the State collection had been nearly destitute of fossils from the rocks of Delaware county, which according to the map is occupied by the Cattskill group. Some time since Prof. Orton, late of the Normal School in Albany, sent to the State Cabinet numerous specimens from the so-called Cattskill group of that region, and they were thus arranged; but I readily recognised nearly all of these as characteristic Chemung fossils. Although obtained within the area colored as Cattskill group, it was still possible to suppose that they might have been derived from transported masses, and no investigation having been made to decide this question, the matter rested.

More recently, Mr. J. M. Way, of Franklin, Delaware County, has directed his attention to the fossils of his neighbourhood, particularly to the fish remains, which he has found in considerable abundance. From loose and scattered masses he has been able to trace the specimens to their position in the hill slopes, and has ascertained the existence of no less than three distinct beds containing these ichthyic remains. Associated with the latter, he has found numerous shells which are typical species of the Chemung group; and these he has traced to near the tops of the highest hills in Franklin, and occupying large areas of what have been regarded as the unequivocal Cattskill group. Mr. Way has sent collections of these fossil remains to several geologists in the country, with a view of obtaining information to aid him in his researches.

Having since personally examined the region in question, I do not hesitate to say that we have in the fossil remains taken together the most unequivocal evidence of the occurrence of the Chemung group in these localities. A section from the north side of the Susquehanna river to the high hills in the south part of Franklin gives the following beds, the characters of which I have not yet studied in detail, and the thickness given may be regarded as approximate:—

1.—Greenish-gray sandstones and shaly sandstones; 100–150 feet to top of hills.

2.—Fossiliferous band with scales, bones, and teeth of fishes; *Aviculo pecten?* and a few Brachiopoda. (Remains of plants occur a little above the animal remains.)

3.—Greenish and gray sandstones, shaly sandstones and shales; about 150 feet.

4.—Fossiliferous band, containing bones and teeth of fishes; Brachiopoda and Lamellibranchiata, among which the *Spirifer mesostrialis*, Hall, is abundant, and *Cypricardites chemungensis* of Vanuxem is common.

5.—Sandstones and shaly sandstones, similar to those above, but less greenish, and sometimes more heavily bedded; between 100 and 150 feet.

6.—A fossiliferous band, similar to the one above, with the same species of fossils, and conspicuously marked by a compact argillo-calcareous band with carbonate of iron, and consisting largely of crinoidal remains in small fragments. Crinoidal bands of precisely similar character occur in the Chemung group in the central and western part of the State.

7.—Non-fossiliferous shale and shaly sandstone, embracing flagstones aud sandstones; about 100 feet.

8.—Red shale and shaly sandstone, with numerous fucoidal remains; 400 to 500 feet.

9.—Greenish and gray shales and shaly sandstones, with darker shales to the top of the Hamilton group; the thickness not well ascertained.

10.—Hamilton group.

Associated with these fossiliferous beds, and more conspicuously with the upper ones, we have bands of a peculiar greenish shaly conglomerate or cornstone, which likewise contain fish remains. These cornstones, with their fossil remains, were noticed by Mr. Vanuxem in his report upon the adjacent country.

There is a thickness of between 1,000 and 1,200 feet above the Hamilton group, the lower half of which is not yet known to be fossiliferous beyond the fucoids in the red shaly sandstone.

This red shaly sandstone and the dark and green shales below, together with the non-fossiliferous beds of No. 7 of the section, represent the Portage group; while the upper members are always marked by characteristic fossils of the Chemung group.

I have carried forward observations across the country from the Susquehanna to the Delaware river, and up to the "head of the Delaware" at Stamford; and I am satisfied that in the region

to the north and west of the west branch of the Delaware, and to a great extent (if not entirely) the east and west branches of the Delaware, there are no beds of rock of more recent age than the Chemung; and, from what I have seen elsewhere, I am inclined to believe that until we ascend the slopes of the Cattskill mountains, and rise to an elevation of at least 2,000 feet above tide-water, we find no rocks of newer age than the Chemung group.

The Cattskill group has been compared with strata newer than the Chemung group, and consisting mainly of red and greenish shales and shaly sandstones. I am now satisfied that the red shaly sandstone near the base of the section, as here presented, has misled most of those who have heretofore investigated these rocks; while at the same time the harder and more arenaceous character of the Hamilton rocks in their eastern extension (in which character they simulate the Chemung rocks,) has caused them to be identified with the latter. I am satisfied, moreover, that through this means Mr. Vanuxem was misled; and though I have not reexamined the section at Mount Upton, the locality of the characteristic bivalve shells, I am not willing to believe it will prove to be newer than Chemung, even if it be much above the top of the Hamilton.

You will perceive, therefore, that all the specimens of plants sent you as coming from the Cattskill group are really from beds of the Chemung group proper; and, so far as possible in this hastily written note, I have given you my reasons for adopting this belief.

In looking back to the history of the adoption of the term Cattskill group, it would appear that there was not entire unanimity as to its signification in some points, among the geologists of the 1st, 3rd, and 4th districts.

Prof. Mather, in adopting the term, says it includes Nos. 9, 10, 11, and 12 of the Pennsylvania Survey; while Mr. Vanuxem restricts it to No. 9. As both these gentlemen placed it above the Chemung group as defined in central and western New York, I regarded it (without having made personal examination) as identical with a red shaly sandstone and conglomerate which clearly comes in above the Chemung in the adjacent counties of Pennsylvania bordering the 4th district. Having considered the Chemung group as No. 9 of the Pennsylvania Survey, I regarded the red rock with Holoptychus as No. 11; the conglomerate, No. 10,

had not been recognised in my district, or adjacent to its southern limits.

I consider that at this time there can be no doubt that the Chemung group is identical with No. 9 in the original nomenclature of the Pennsylvania Survey; and the term Chemung group having been adopted, and well understood in its relations and signification, and well marked by its fossils, we cannot with any propriety continue to extend the term Cattskill group over a large area occupied by the older rocks, and well characterised by their contained fossils.

Mr. Mather, in his descriptions of the rocks, has recognized the Chemung group as lying below the Cattskill group, but, as I have shown, the area colored by him as Chemung, is really Hamilton group; and it now becomes necessary to restrict the term *Cattskill group* to the beds above, or to those formerly known as X and XI of the Pennsylvania Survey.

Adopting this view, which is imperatively required of us, some modification is necessary in the reference of certain fossils; but I am satisfied that it will remove one great cause of misunderstanding relative to the groups of strata on the confines of the coal measures; and we shall avoid the complication which must ensue from referring the same species of fossils to two distinct groups of strata, according to the present application of our nomenclature.

On reference to the Geological Reports of New York, you will observe that the fossils of the Cattskill group, given in the 1st and 4th Districts, are of plants, with two species of shells. The red shaly sandstone, (called old red sandstone or Catskill group,) resting in outliers on some of the higher hills in the 4th district and occuring in continuous strata in Pennsylvania near the southern limit of New York, did not afford specimens of these plants or shells; while the scales and other remains of Holoptychius are the characteristic fossils of the rocks in these western localities. But so far as I am aware, no scales of Holoptychius have been found in the area colored as Cattskill group in Delaware and the adjacent counties on its west.

In tracing the Chemung group westward, there are many indications that it may yet require to be restricted in its designation. The Waverly sandstone group of the Ohio Reports, at one time regarded as entirely equivalent to the Portage and Chemung groups, may in its upper members constitute a distinct group, though we do not yet know any line of demarcation between them.

ARTICLE. XXXV.—*Some observations relating to the physical condition of the superficial deposits in Canada.* By CHARLES ROBB, ESQ. C. E. Montreal.

(*Read before the Natural History Society, Nov.* 1862.)

I.

The structure of the fundamental rocks of Western Canada and their geographical boundaries, have been thoroughly ascertained and defined by the Provincial geologists; and from the simplicity of that structure, the regularity of their sequence, and the slight alteration both in position and mineral character, which they have undergone since their original deposition, this part of their task would have been comparatively easy, were it not for the thick masses of clay; sand and gravel which for the most part envelop and conceal them. Athough the *Drift*, as these superficial deposits are called, is one of the most recent of all the geological formations, its date being immediately before the creation of the existing species of organized beings, it seems remarkable that its precise nature and origin should be less clearly understood than those of the more ancient rocks on which it reposes. Apart from the interest attaching to the subject in a purely scientific point of view, its investigation is of the utmost practical importance in an agricultural country like this; as such knowledge is calculated to render material aid in understanding the nature and durability of our soils, and in determining the best methods of developing their resources and preventing their deterioration. To these investigations, in so far as they refer to Lower Canada, Dr. Dawson has devoted much attention and made many valuable contributions, and in the Upper Province the researches of Professor Chapman of Toronto, and of Mr. Robert Bell, under the direction of Sir Wm. Logan, have thrown much light on the subject; and we may shortly expect to be put in possession of the result of their combined labours in a lucid and condensed form by the publication of Sir Wm. Logan's elaborate General Report on the Geology of the Province.

The three accomplished observers whom I have named agree, upon independent grounds, in dividing the superficial deposits of Canada into a lower and upper member; the former consisting chiefly of dark blue and greyish clays, the debris of the underlying limestone, and nearly destitute of boulders; and the latter of sand and gravel of granitic and gneissoid origin, with numerous

boulders. Throughout Lower Canada, and as far west as Kingston, the relative age of these deposits has been determined by appropriate fossils of recent or existing species; and although these are wanting in the Upper Province, the analogy is presumed to be established by other characteristic features. The fact to which I would desire to call your attention, and which I am not aware of having been previously observed, is that the older formation prevails almost exclusively in Western Canada on the elevated platform bounded on the east and north by the Niagara escarpment, which sweeps in a bold and abrupt manner from the Niagara river round the head of lake Ontario, and northwards to Cabot's head on Lake Huron, forming a very marked feature in the physical geography of the Province. The whole of the country, for a great distance to the east of this line, and especially towards the base of the escarpment, is thickly strewn with sand, gravel and boulders of Laurentian origin; while to tbe west these are of very rare occurrence, and are replaced by materials evidently derived from the disintegration of the underlying limestone rocks. From the Niagara escarpment westward to the height of land near Woodstock, this difference is less marked than from that point still farther west to the shores of Lake Huron. The influence which I would draw from these facts is one which corroborates the view which has been entertained by Sir Charles Lyell and others, who have examined the physical geography of Canada; namely that the contour of the fundamental rocks of the country has been impressed upon it at an epoch long anterior to glacial or drift period; and that the elevated platform of the western peninsula, if not actually above the level of the sea at that period, was sufficiently high to resist the intrusion of the ice islands charged with the debris of the Laurentian and other more ancient northern rocks, which would be drifted by the glacial currents from the north-east.

The chemical composition of the drift clays of the more westerly parts of the province, as compared with those of the east, offers a remarkable corroboration of this view. By the analysis of Mr. Hunt, a specimen of the sub-soil clay from a district west of London, and which may be taken as an exponent of the constituent elements of the clays of the whole western district, yielded not less than 29.40 per cent of carbonate of lime; while a similar specimen from the Niagara district gave only 15.30 per cent. In fact, in some of the few places in the west where the rocks and

calcareous shales are exposed they may be seen decomposing into clay; while the fossils and fragments of stone found in the clay are sharp and angular, indicating that they have not travelled far from their native beds. Probably this fact of the great excess of calcareous matter in the western soils may account for the superior nature of the timber which grows there, as well as for the superior fertility and early period of their vegetation and harvests.

II.

Many of the facts connected with the physical condition of the superficial deposits in Canada, and especially of the vast ochre-beds and deposits of marl, bog iron-ore, &c., are attributable to the existence of powerful chemical actions which have been for indefinite periods, and still are in action at no great distance from the surface. I beg to call attention to certain phenomena illustrative of this subject, which have partly come under my own observation, and partly been related to me by trust-worthy witnesses. No doubt similar facts might be discovered in many other parts of the Province, should they happen to come under the notice of competent observers.

In the month of October, 1859, I visited the farm of a friend who resides on the 1st lot of the broken front range on the road passing through Arkona village, in the township of Bosanquet. This point is, according to the determination of our Provincial Geologists, immediately on the line of junction of the Corniferous limestone and Hamilton shales of the Devonian formation; and as it has been observed that metallic deposits occur most frequently in the neighborhood of such junctions, which may possibly affect their formation, it may reasonably be inferred that some connection exists between the phenomenon I am about to relate and the existence of such deposits. I am not prepared to give an exact explanation of the causes of the proximate chemical reactions which are found in operation at the locality in question; still less do I feel competent to offer any solution of the vexed question of the origin and mode of formation of mineral lodes; I shall simply relate the facts as a slight contribution to our knowledge of the chemical geology of some of the superficial deposits, and possibly also of the formation of metallic veins.

The river Sable flows through the lot in question at its northern extremity, and at the distance of about 200 yards to the south their occurs upon this lot a tract of low-lying ground

running parallel with it, the intervening space being for the most part a marl-bed. In this dell or ravine numerous springs exist, which constantly pour forth large quantities of water strongly impregnated with iron; the water on coming to the surface is clear, transparent and colorless, but with a strong ferruginous taste; and very shortly after exposure to the air it yields an oleaginous-looking scum of a highly iridescent appearance, which floats on the surface of the ditches, but quickly dissipates and subsides to the bottom, forming a deposit of hydrated peroxide of iron or ochre, which is found here and in some of the neighboring lots in beds varying from one to three feet in thickness, and of an extent and quality which seems to be economically available, although much mixed with vegetable remains. The springs impregnated with this ferruginous matter penetrate a bed of clay about ten feet in thickness, and where they are strongest appear to have excavated holes in the clay-bed, forming natural wells; but it is a remarkable fact that they appear to run in veins in a south-easterly direction, as there occurs between two of the strongest springs at a short distance apart another very powerful and deep spring, which is comparatively free from ferruginous matter. This latter spring which has entirely cut away the clay to a diameter of about six feet, forming a well as regular as if artificially excavated, apparently yields remarkably pure and clear water, and is intermittent in its action, occasionally throwing up the water with great violence to the height of about eighteen inches above the surface, as if from the effects of gaseous pressure applied under the source of the water.

I should here state that the rocks of the country abound in iron pyrites, and loose masses of this substance are found abundantly strewed all around.

In this natural well, my friend who resides on the lot found, on probing the quick-sand at the bottom, with a pole to a considerable depth, a long straight wooden twig about an inch in diameter, with a little bag of deer-skin tied to one end with a thong of the same material, and coated all over with a bright metallic substance resembling tin, and which on submitting a portion of the stick to my friend Dr. Hunt, he pronounced to be of the following nature and origin: "The specimen of wood is very interesting, in as much as the hard metallic coating is *Iron pyrites*, formed by the decomposing action of the organic matter of the wood upon the sulphates in the water, in presence of a solution of

iron. The same reaction takes place when oxide of iron is put into a close vessel with any vegetable matter, sulphate of lime being present; and such, or a similar process, I conceive to have intervened in every case where metallic sulphurets are found in nature."

For what purpose the twig with the leather bag had been used and how long it had been immersed in the water, I am unable to state, nor have I had any opportunity of ascertaining the chemical composition or temperature of the water yielded by the springs referred to. At one place I observed that the water was very sour to the taste, and probably contained a small proportion of free sulphuric acid. I was informed that occasionally the air in this ravine was oppressively hot and sulphurous, and that when a slight fall of snow would lie in other parts of the lot, it would rapidly melt here. A salt well occurs at no great distance from this place.

Towards the southeast of the spot more immediately referred to, and at a distance of about half a mile from it, there occurs a series of remarkable pits or depressions in the earth, some long and irregular, but mostly conical or funnel shaped, and ranging in a line with each other and with the hollow where the springs are situated, but at a considerably higher elevation. The conical pits are remarkably regular in shape, and judging by the eye, may be about 50 feet in diameter by about half that in depth. That they are of very recent origin is proved by the fact that in more than one instance I found trees of no very great age growing perpendicularly to their sloping sides.

I have now to direct attention to a very singular and interesting occurrence at the locality in question, which, taken in connection with the details I have already given may throw some light on the subject of earthquakes and their associated phenomena. The facts I have now to state are given on the authority of my friend who resides on the lot, and whom I know to be a very intelligent and trustworthy observer; and as it is best that facts of this nature should be given circumstantially, and in the language employed by the observer at the time of their occurrence, I shall quote from his own letter written within two days after the event; premising that the frame house in which he dwells is situated on a rising ground immediately above, and in full view of the hollow in which the remarkable springs occur.

Bosanquet, 8th January, 1861.

.... "One singular occurrence which happened on the 6th inst., I will state as fully as my time will permit. Having retired to bed for the night about 9 o'clock, p. m., we had scarcely lain down when my wife became alarmed, by the appearance of flashes of light entering our bedroom windows; and supposing the house on fire, to satisfy her I got up, looked out and around, and found all right. I noticed the flashes of light before my wife did, but supposing she might be alarmed needlessly said nothing. After laying down, it appeared two or three times again, the light continuing for about two seconds or so each time, accompanied at this time by a dull rumbling noise of about six or seven distinct pulsations. The light appeared to shine and the noise to come from a point about four or five chains up the hollow above the large spring north of the house, and within two or three chains of the house. The sky was somewhat clouded at the time; the sounds were very distinct and abrupt; and the reflection of the light appeared a mixture of pale red and intensely bright but mild light.

"Next morning a neighbour met me on the road, and asked me what I thought of the curious 'phenomenon,' as he called it, we had lately. On asking him what he referred to, he stated that his son-in-law, who has lately built a house on the corner of the clearing next to us, and in the line of, and between two of those pits or depressions the range of which I pointed out to you the day you left us—the two pits and house range S. E. with the hollow below our house, where the deep spring is, and about 25 or 30 chains S. E. from the spring—his son-in-law told him that he heard curious noises the previous evening, that the log-house shook, and some tin dishes were thrown from the shelves to the ground, and that next morning he observed a line of vapor along the line of the depressions, which vapor seemed to be ejected upwards in several places with considerable force; it was about daylight the next morning that the vapor was seen. I noticed it too when I went out early in the morning, at which time there was a rapid thaw. I went to the great spring to see the effect of the thaw on the ditches. I did not then notice any difference, except a depression in a part of the hollow below the spring, as if of late occurrence, and a large increase in the limbs, twigs, etc., which still continue to be thrown up. For the last two weeks the spring has

been precipitating in the channel flowing from it, a very large increase of coloring matter, and of a deep clear red color." ....

The inference which I would draw from all the circumstances I have so minutely detailed is, that powerful chemical reactions are at the place referred to, in constant operation at the surface or in fissures of the rocks underlying the superficial deposits, decomposing the pyrites and converting it into the sulphate of protoxide of iron, which is soluble in water and is brought to the surface by the springs, and then receiving oxygen from the atmosphere, and being affected by the alkaline solutions also contained in the water, is again changed with the insoluble peroxide and precipitated on the surface of the ground, forming an ochre bed. The abstraction of the material thus displaced will, in the long process of these operations, leave cavities under the surface which must be filled by the subsidence of the superincumbent earth in the same manner as is often observed in places where coal beds have been entirely excavated and abandoned. I have little doubt that the remarkable dell or ravine which I have described is of this nature and origin; and that the series of isolated pits or depressions ranging in the same line with it is only a continuation of it, but at a less advanced stage of formation.

To account for the oxidation of the pyrites, which I have supposed to be the primary cause of all these phenomena, is not such an easy matter, unless we can conceive it to exist in the bowels of the earth in a minutely subdivided state.

"It is well known," says Sir Charles Lyell, "that mixtures of sulphur and iron sunk in the ground and exposed to moisture give out sufficient heat to pass gradually into a state of combustion, and to set fire to any bodies that are near. If a large quantity of clean iron filings be mixed with a still larger proportion of sulphur, and as much water as is necessary to make them into a firm paste, let the mixture be then buried in the earth and the soil pressed firmly down upon it. In a few hours it will grow warm, and swell so as to raise the ground. Sulphurous vapors will make their way through the crevices and sometimes flames appear. There is rarely an explosion, but when this happens the fire is vivid and if the quantity of materials is considerable, the heat and fire both continue for a long time."

The spontaneous combustion of beds of bituminous shale and of the refuse coal thrown out of mines is also generally due to the decomposition of pyrites—and it is the contact of water,

not of air, which brings about the change. A smouldering heat results from the various new combinations, which immediately take place when the sulphur and other substances are set free. Similar effects are often produced in mines where no coaly matter is present, when substances capable of being decomposed by water are heaped together.

This explanation may suffice to explain in a general way not only the production of the ochre beds from the decomposition of pyrites, but also the flames, vapors, and pulsations and subsidence of the ground.

The deoxidation of the protoxide of iron dissolved in the water, and its reconversion with the sulphuret through the agency of the organic matter of the wood, is a highly interesting and instructive fact, and throws much light on the origin not only of bog iron ores but on the formation of mineral deposits in general. It affords a striking illustration and coroboration of the theory now generally received among chemical geelogists, that the origin of the metallic sulphurets found so copiously in nature is due to a similar reaction through the agency of organic matter on the soluble sulphates contained in the primeval waters; but on this point we cannot at present enter.

ART. XXXVI.—*Remarks upon Prof. Hall's recent publication, entitled: " Contributions to Palæontology."* BY E. BILLINGS.

I have this day (4th November, 1862) received by mail a publication by Professor James Hall of Albany, purporting to be a continuation of Appendix C, of the Fifteenth Annual Report of the Regents of the University of New York.

On page 169 there is the following notice:

" *Twelfth Annual Report of the Regents on the State Cabinet.*

THE first seventeen pages of the palæontological part of this Report were printed and stereotyped in January and the early part of February, 1859; and nearly one hundred copies were distributed immediately thereafter. The entire report was printed and published previous to the 20th September, 1859; and any person, procuring proof sheets from the printer "*in the beginning of the month of August*," must have obtained the sheets at least as far as page 56, which had been printed in the early part of July. The proof sheets of the Tenth Report were in like manner *procured from the printer*, as fast as issued. Similar practices have been resorted to by interested parties, with respect to other reports; proof-

sheets having been obtained from the printing-office, many months in advance of publication: and I wish simply to record the fact in this place. I had supposed that authors considered such proceedings disreputable, and I scarcely believe that there can be a difference of opinion among gentlemen in regard to acts of this kind. [See Canadian Journal of Industry and Science, N. S. No. 34, p. 355; and Canadian Naturalist and Geologist, Vol vi, No. 4, p. 317.]

The two articles, in the "Canadian Naturalist" and "Canadian Journal," referred to at the end of the above quotation were written by me and published under my name; and it would appear therefore that Professor Hall is desirous of having it understood that I procured the proof sheets of some of his works before publication. In answer to this charge, so unfairly made, I shall only say that I never procured either directly or indirectly a vestige of the proof sheets of any of his works either before or after publication, with one exception, and this by no fault of mine. The circumstances are as follows, and they are well known to him. In Silliman's Journal for July, 1859, p. 149, I saw a notice of a pamphlet of 18 pages, published by Prof. Hall. This was the portion of the Twelfth Annual Report referred to by him in the above quotation and which he says was printed in January and February, and published "immediately thereafter." As the criticism in that Journal pointed out that Prof. Hall had described one of my genera under a new name, I naturally felt desirous of seeing the work. No copy had been sent to our survey, although according to his own showing it had been published five months. I wrote to a friend in Albany to procure one for me. I did not ask for the proof sheets but for the work itself. My friend could not get a copy but sent me several loose leaves, some of which were evidently proof sheets, as they were printed only on one side and had some corrections in the margin. There were 25 pages and 17 of these had been published as above stated some months previously. The other 8 pages contain the genera *Nucleospira*, dated by him 1857; *Trematospira*, 1857; *Rhynchospira*, 1857, *Tropidoleptus*, 1856, and part of *Leptocœlia* 1856.* Now, when an author places dates after the

* It is of great importance that the dates of genera and species should be correctly given at first. Many of Prof. Hall's are either erroneous or ambiguous. I do not admit that those here cited are the true dates.

names of his genera, he gives the public to understand that he has described the genera in question in some other work, published at the time indicated by those dates. On Prof. Hall's own showing therefore, the first 17 or 18 pages of the sheets in my possession had been published about five months, and the substance of the other 8 pages two or three years before I procured them. He says that there must have been 56 pages, but this assertion is totally untrue; I received only 25.* An intimate friend of his saw them in my room, and informed him that I had some of his proof sheets. This same friend afterwards called and said he had been instructed by Prof. Hall to inquire into the matter. Fearing they might get some innocent person into trouble (although I could not see how), I refused to give him any further information than he possessed; and, besides, removed the sheets from my office, and never saw them again until this day. The above are all the facts relating to these proof sheets, and the reader can see that it was not intended to take any advantage of Prof. Hall; and, further, that the work came into my hands in the form of sheets quite accidentally, and with no desire on my part to procure it in that form. Prof. Hall is well aware of all the circumstances, and why cannot he give a true and fair account of them. By blending a mere particle of truth with a great deal that is not true, he has magnified 25 pages obtained unintentionally after publication, into whole volumes of proof sheets procured designedly before. This is only a continuation of the unfair treatment I have received from him during the last four years.

It may be that the proof sheets of the tenth and other reports mentioned by him were obtained by parties interested in their contents, but they never were by me; and yet by a special reference to two articles well known to have been written by me, he makes it appear that I procured them. I would recommend all persons

* In one of my papers I have said 18 pages, but I had not the work before me, and supposed I had only the number mentioned in Silliman. I have, in order to make certain, looked them up and find that there are 17 leaves, the first nine of which were printed on both sides, and the other 8 on one side only. There were thus, just 25 printed pages besides the title page. The fact of the last 8 leaves being printed on one side only, convinces me that the work had only proceeded as far as page 25 when these sheets were procured. I shall always believe therefore that the description of *Triplesia* on page 44 (of the 12 Rep.) was drawn up after Prof. Hall had seen my description of *Camerella*.

who may have occasion to read Prof. Hall's papers to examine them closely, as it is not unusual for him—especially in questions of priority—to arrive at decidedly erroneous conclusions.

I shall now proceed to point out a few palæontological errors in his new work.

1. The genus *Cryptonella*, illustrated on Pl. 3, p. 133, is precisely identical with *Charionella*, described by me in the Canadian Journal of March, 1861, p. 148 and illustrated in the May number, p. 273, 274. It includes the species described by Prof. Hall in the Thirteenth Report under the names of *Meristella Haskinsi*, *M. Barrisi*, *M. Doris*, *Terebratula Lincklæni*, *T. rectirostra* *T. lens*, *and T. planostria*. Besides these the *Atrypa scitula* of the N. Y. Reports, *C. Circe* and apparently a number of European species belong to it. *Cryptonella* was first published in July or August, 1861, three or four months after the learned author became acquainted with its characters through the study of my papers.

2. *Centronella impressa*, Pl. 3, figs. 1–5, is *C. Hecate* published by me in the Canadian Journal, May 1861, p. 272. The date of Prof. Hall's description is July or August of the same year.

3. *Euomphalus* (*Straparollus*) *Clymenioides*, Pl. 6, fig. 3, is *Straparollus Canadensis* described by me in the begining of July 1861, in the Canadian Journal Prof. Hall's species was published in October 1861.

4. At page 166 we have the plate with the suppressed figure of Conrad's genus *Cypricardites*, well copied in full. Palæontology is indebted to me for the publication of this important plate. Had I not described the genus *Cyrtodonta*, I fear it would have remained for ever in the dark. The reason given by Prof. Hall for publishing it now is simply that I charged him, in a respectable journal, with holding it in his hands for eighteen years without publication. I here reiterate that charge. There was no mention made of this figure in any of Prof. Hall's publications from the time it was drawn in 1840, or thereabouts, until the yea 1859. His ideas with regard to the laws of scientific nomenclature are not correct. The rule applicable in this case is, that if a name imply that the genus belongs to a family, order, or class different from that to which it does actually belong, then it should be changed. For example, if the Trilobite *Bathynotus* were to be called *Bathyocrinus* or *Bathy-*

osaurus, it could not be retained, no matter how long in use, because it would be absurd to give a Trilobite a name which would imply that it is a Crinoid or a Saurian. So with *Cypricardites.* The name implies a close affinity with *Cypricardia*, a genus of the family Cyprinidæ, while the fossils to which Prof. Hall would apply it belong to a different family, Arcadæ, or rather to a group which appears to form a passage between that family and Aviculidæ. The name *Athyris*, quoted by Prof. Hall as affording an analogous case, is quite a different instance. It does not refer the genus to any family, and is only objectionable when used for species with a perforated beak. And for this reason, some of the best palæontologists reject it altogether. Even Mr. Davidson who still uses it, says that he would have adopted D'Orbigny's generic name *Spirigera*, had he not been influenced by other authors (British Carboniferous Brachiopoda, p. 79). The greatest authority on the Brachiopoda thus retains *Athyris* for shells with perforated beaks, simply in deference to the views of others and contrary to his own convictions.

5. The genus *Zygospira*, p. 126, is not separable from *Atrypa.* The connection of the two spires is not of generic importance. The same structure occurs in *Spirifera*, some species of which have the spires connected and others not. *Atrypa modesta* is scarcely distinguishable from *A. erratica* (*Orthis erratica* of the Pal. N. Y., Vol. 1), and this latter again passes into *A. Headi.* In these two species the shell structure is precisely that of *A. reticularis.* I have referred them to *Athyris*, at the same time stating that it would become necesssary to place them in the genus *Atrypa*, should the position of the spires be found similar to those of that genus. (See New Species of Lower Silurian Fossils, June 1862, p. 146.)

6. *Orthis emacerata*, Pl. 2, figs. 1, 2, 3, is not separable from *O. testudinaria.*

7. The mistakes with respect to *Barrandia* and *Clioderma* were first pointed out by me, and so were the affinities between *Rhodocrinus* and *Thysanocrinus.* The corrections are published in this book as if they were original.

8. Specimens of *Phragmostoma* from Tennessee in my possession have a circular aperture in the septum.

ART. XXXVII.—*Remarks on* Tænia pectinata. *In a letter from Dr. T. Spencer Cobbold, M.D., F.L.S., London (England), to Professor Lawson, Queen's College, Kingston.*

(For the Canadian Naturalist.)

39 Norland Square, Notting-Hill, LONDON, W.,
Monday, September 22nd, 1862.

MY DEAR SIR,—You have rightly conjectured that I am still interested in Entozoa, and I thank you much for your thoughtful consideration in troubling yourself to send me some Cestode parasites. You may be sure Pouchet and Verrier's observations have not escaped me, and I flatter myself very few other authors who write on Entozoology are unknown to me by name or otherwise.

The tape-worms you have so kindly sent are very interesting specimens.* I make no doubt that they are referable to the

TÆNIA PECTINATA, Goeze.

T. pect. also of Schrank, Gmelin, Rudolphi, Batsch, Bremser, Dujardin, and Diesing.
T. acutissima Leporis of Pallas.
T. Leporina, Limbourg.
T. Cuniculi sylvestris, Doubrenton and Marigues.
T. Marmotæ, Frölick.
Alyselminthus pectinatus, Zeder.
Halysis pectinata, also of Zeder.

Nine out of every ten zoologists would have described your worm as a new species, but I protest against the system which some here adopt of never looking up the older writers.

Hitherto this worm has only been noticed in the hare (*Lepus timidus*), rabbit (*L. cuniculus*), and marmot (*Arctomys Marmota*), and therefore its occurrence in *Hystrix dorsata* is a novel fact of very considerable interest.

This Cestode is very like (at first sight) a new tape-worm just discovered by Leuckhart, as infesting the human body and dogs in North Greenland (*Bothryocephalus cordatus* of Leuckhart); but its essential characters are very different. In *B. cordatus* the

* The specimens were obtained from the intestines of the Canada porcupine (*Hystrix dorsata*), male and female individuals of which were shot by Mr. Fox and Mr. Moore during one of Prof. Lawson's expeditions to the Rideau and Gananoque Lakes.

head (as seen under the microscope) presents quite a different appearance, whilst the reproductive organs are differently disposed. In those you sent me they are *all on one side*, but some of the above-mentioned authorities state that their position is sometimes reversed. This I suspect is an error.

Yours very truly,

T. SPENCER COBBOLD.

Prof. George Lawson, LL.D.

ARTICLE XXXVIII.—*Col. E. Jewett, of Albany, on the geological age of the rocks of New York, heretofore referred to the Old Red Sandstone.*

The following account of the important discovery made by Col. Jewett is given in the Fifteenth Annual Report of the Regents of the New York University.*

"A few week since, an interesting collection of teeth and plates of fishes, supposed to be from the Old Red Sandstone of Delaware county, was received at the Geological Rooms. The Curator was directed to visit the locality, for the purpose of enlarging the collection. The following is his report.

ALBANY, September 20, 1862.

DR. WOOLWORTH, Secretary of Regents, &c.

Agreable to your directions, I went to Delaware county, to collect fossils from the Catskill group, or Old Red Sandstone.

At Franklin I found Mr. J. M. WAY, a gentleman who for years has been examining the rock and collecting the fossils ; and although he is unacquainted with any other localities, and has never seen a collection of fossils, he has succeeded in investigating the whole strata of the neighborhood, and collecting many fossils. With his assistance, I was able to make a section from the Oleout creek to the top of a hill about three miles southwest of the vil-

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* I received a letter from Col. Jewett in September last, containing the results of his researches in the so-called Catskill group. It will be observed by another paper published in this number that Prof. Hall indirectly associates himself with the discovery ; but I am informed that he did not visit the locality until after Col. Jewett had been there and decided the question.—E. B.

lage of Franklin, more than 800 feet in thickness. The base is a brick red shale, with occasional red argillaceous sandstone, about 400 feet. On this is about fifty feet of greenish shale; on which lies a stratum of gray sandstone, with teeth and plates of fishes, and fossils of the *Chemung group.* Seventy feet of green shale lies on this fossiliferous stratum; when another thin band of fossils, with gravel and the same formation, continues with alternate shale and gray sandstone and fossils to the top of the hill, where the Chemung fossils are more numerous. Spirifers, Rhynchonellas, Pectens and Athyres are found in all the strata of the upper three hundred feet, and the whole formation is undoubtedly Chemung.

I examined other localities with the same result.

Mr. Way has examined the rock as far as Deposite (twenty-five miles southwest), with great care, and finds the same formation. He has also collected the same fossils at Delhi, seventeen miles southwest.

From my investigation, I believe there is no Old Red Sandstone in this State. I found no forms among the fish remains like those of the Old Red Sandstone of Great Britain, but we have plates far larger than those found there.

The Teeth closely resemble those described by Dr. Newberry, from the Corniferous rocks of Ohio and New York.

Respectfully your obedient servant,

E. Jewett."

MEETING OF ENTOMOLOGISTS.

In accordance with the suggestion made in the June number of the *Naturalist*, that a meeting of those interested in the study of Entomology, should be held in Toronto, during the Provincial Exhibition, a number of ardent votaries of this branch of science assembled at the residence of Professor Croft, on Friday evening, September 26th. The following gentlemen were present:—Rev. Prof. Hincks, F.L.S., and Prof. Wilson, LL.D., of University College; Thomas Cottle, Esq., Woodstock; Thomas Cowdry, Esq.; M.D., York Mills; W.L. Lawrason, Esq., London, C.W.; Beverley R. Morris, Esq., M.D., Toronto; E. Baynes Reed, Esq., and William Saunders, Esq., London, C. W.; and Rev. C. J. S. Bethune, B.A., Cobourg:—a very fair representation, on the whole, of the Entomologists in the western portion of the Province. Several

gentlemen signified their regret at being unable to attend, in consequence of other engagements, while they expressed at the same time their hearty approval of the objects of the meeting.

Its first and great object was, naturally, the formation of an Entomological Club, or Society. After some discussion upon the subject, it was decided that, in consequence of the smallness of the number present, no definite organization should be formed as yet; but that another meeting should be held during the ensuing spring, due notice of the time and place being previously given to all interested. It was further agreed upon, that the objects of the contemplated society should be,—first, the formation of as complete a collection as possible of Canadian Insects, to be kept in some central place for general information and reference; secondly, the charge of a depository of duplicate specimens contributed by Entomologists for distribution among its members; and thirdly, the holding of meetings from time to time for mutual information, and the advancement of the science throughout the country at large.

The greater portion of the evening was most pleasantly spent in examining and admiring the very extensive and beautiful collections of Prof. Croft, as well as those of others kindly contri buted for the occasion. A brief enumeration of their several points of interest will not, it is hoped, be out of place here. First and foremost, must be mentioned the large and varied collections of both native and foreign Insects displayed by Prof. Croft,—among the former, his Longicorns and several other families of Coleoptera, attracted general observation, both from the rarity of many of the specimens, and the completeness of the series; and among the latter, his huge Chinese beetles—including the *Dynastes Herculi*,—and magnificent moths, were very much admired. Too much indeed, cannot be said of his various collections, the inspection of which so greatly enhanced the enjoyment of the evening.

Dr. Morris exhibited a number of rare specimens of Lepidoptera, among which may be mentioned *Polyommatus epixanthe*, a new addition to our Canadian butterflies; *Darapsa myron*, *Sphinx Kalmiæ* and other Sphinges; that pretty Lithosian *Gnophria vittata*, etc. He also brought a number of Coleoptera, as well as several interesting specimens of both orders collected by him in the neighbourhood of Portland, Me.,—of these last, his specimens of *Satyrus alope*, *Strangalia fugax*, *Chrysochus auratus*, and *Meloe ?*—were particularly fine.

Mr. Saunders (who took the first prize for his collection of Insects at the recent Provincial Exhibition) brought a number of the rarer specimens to the meeting. The most remarkable among them were :—that magnificent butterfly *Papilio thoas*, not itself a native specimen, but yet highly interesting as being a representative of a species occasionally found in Canada; *Terias liza*, *Melitœa phæton*, *M. ismeria*, *Thecla acadica*, (a new species discovered by Mr. S.,) *T. niphon*, *Lycœna Scudderii*, (with specimens of which he will be happy to supply any Entomologist,) *Polyommatus dorcas*, *P. Comyntas*, and other rare butterflies. His undetermined specimens of Hesperidæ, and Sphingidæ also attracted notice. This gentleman with characteristic liberality, brought also a large case of duplicate specimens for distribution among all who wished for them.

Mr. Reed, who had just returned from a visit to the old country, exhibited a complete collection of English butterflies, the specimens of which were very perfect, and also some ingenious apparatus for collecting purposes, including a pocket butterfly net, lantern for attracting Noctuadæ, etc.

Mr. Lawrason brought a very remarkable specimen of the group *Sphingina*, captured in the vicinity of London, C. W. It has been submitted to the inspection of several eminent Lepidopterists, and is considered by them as quite *sui generis*, differing from anything they had ever seen before.

Dr. Cowdry exhibited a number of English specimens of Lepidoptera and Coleoptera, chiefly conspicuous among which were the moths *Anthrocera filipendulœ*, *Callimorpha Jacobœœ*, several *Curculionidœ*, etc.

Rev. Mr. Bethune contributed specimens of several rare insects, including the butterfly *Melitœa mylitta;* a very beautiful sphinx, *Thyreus nessus;* a new species of *Cicindela*, some foreign *Cetonias*, etc.

Mr. B. Billings, of Prescott, though unable to attend himself, kindly sent up several cases of interesting specimens, among which were a number of rare and beautiful *Longicorns*, several *Elaters*, some very fine *Noctuadœ*, and a butterfly new to Canada *Polyommatus cratœgi.*

His brother, Mr E. Billings, of the Geological Survey, Montreal, also contributed a few handsome Chinese specimens, and several rare and interesting native Coleoptera.

On the whole, it may be safely affirmed that never before in Canada had such large and varied collections of insects been brought together; the only cause of regret was that there were not more Entomologists to inspect them. The few that were present, however, enjoyed the occasion to the utmost, only separating at a late hour, with grateful thanks to Prof. Croft for his kind hospitality, and unanimous expressions of delight at the pleasant evening they had spent.

Thus passed the first meeting of Entomologists ever held in Canada, the inauguration, it is trusted, of better days and brighter prospects for this, hitherto, much-neglected branch of natural science. May the recollection of it serve as a stimulus to incite those who were present to increase their exertions in this delightful pursuit, and induce others also to look into the world of insects,—an investigation which cannot fail to be replete with unalloyed pleasure!

C. J. S. B.

PROCEEDINGS OF THE NATURAL HISTORY SOCIETY OF MONTREAL.

Aug. 25th. Ordinary monthly meeting; Dr. Hingston, Cor. Sec. in the Chair.

Messrs. B. Hutchins, J. McArthur, B. Dawson, T. C. Griffith, J. Lovell, and C. Freeland were elected ordinary members.

After the usual business, the following donations were presented:—

A crab, several fishes and aquatic plants, for the aquarium. By Jas. Ferrier, Junr. Esq.

Skin of white American Pelican, a field mouse (*Arvicola*), also five skins of fishes from Lake Superior. By G. Barnston, Esq.

Specimens of *Limulus polyhemus* from Orchard Beach. Dr. Dawson.

With several other donations for which the thanks of the Society were voted.

Sept. 29. Ordinary monthly meeting; Dr. Dawson, Vice-President, in the Chair.

Messrs. D. M. Patterson, Percival Winning, and G. A. Holland, were elected ordinary members.

After the usual business, the following papers were laid before the Society and discussed :

On the Physical Geography of Newfoundland, by M. H. Perley, Esq., President of the Natural History Society of New Brunswick. Communicated by the Nat. Hist. Soc. of New Brunswick for publication in the *Naturalist.*

On the Footprints of *Limulus* as compared with the *Protichnites* of the Potsdam sandstone; by Dr. Dawson. This paper published in the *Naturalist*, was explained and illustrated by the author with the aid of specimens and drawings.

On the Apple-tree Borer; by W. Couper, Esq., Quebec. This paper, also published in the *Naturalist*, was illustrated by specimens of the animal and its work, presented by Mr. Couper.

A specimen of the Silkweed (*Asclepias cornuti*) was exhibited by the Hon. Mr. McGee, and a discussion ensued as to the value of its silky coma, and the tough fibres of its bark, as substitutes for cotton and hemp.

The following donations were presented :

Specimens of the young of *Limulus polyphemus.* By Mrs. P. Redpath.

Gold-fish and eels, for the aquarium. By Jas. Ferrier, Junr. Esq

A collection of fish from the St. Lawrence ; a large specimen of *Amia ocellicauda* from Lake St. Peter ; a specimen of the Canada jay ; eggs of *Emys picta.* By Mr. William Hunter.

Continuation of the voyage of the frigate Eugenies. From the Academy of Stockholm.

Oct. 27th. Dr. Dawson, Vice-President in the Chair.

The following donations were presented :—

From James Ferrier, Junr. Esq., Fishes for the Aquaria.

From G. Barnston, Esq., several skins of fishes from Lake Superior, also the skin of a young beaver.

From Mr. W. Hunter, a specimen of *Picus hirsutus.*

From Dr. Van Courtlandt, specimens of *Gasterosteus* and *Leucisus.*

From Dr. Dawson, a paper on Carboniferous Reptiles from Nova Scotia, by Prof. Owen.

From the Lit. and Phil. Society of Manchester, vol. 1, and vol. 2, part 1st, of its Memoirs; with various periodical publications from different donors.

THE

CANADIAN

NATURALIST AND GEOLOGIST.

Vol. VII. DECEMBER, 1862. No. 6.

ARTICLE XXXIX.—*On the Mammals and Birds of the District of Montreal.* By Archibald Hall, M.D., L.R.C.S.E.

(*Concluded from page* 316.)

Order VI. Palmipedes.

Fam. I. Brachyptera.
Genus Colymbus.

Gen. char. Bill straight, smooth, compressed, and more or less acuminate; nostrils basal, lateral, linear; feet more or less completely palmated.

Sub genus Podiceps.

Sub gen. char. Bill moderate, robust, straight, hard, compressed; points more or less subulate; upper mandible furrowed deeply and broadly to the centre in which are situated the nostrils which are basal, lateral, and pervious, the posterior half covered by a membrane; feet situated far back; the tibia mostly hidden in the body; tarsus compressed; front toes depressed, connected at base by a membrane which forms a broad lobe round each toe; hind toe compressed; nails wide and flattened; wings short and narrow; 2nd and 3rd primaries subequal and longest; tail wanting, but in its place a small tuft.

P. cornatus. Horned Grebe.
Colymbus cornutus of Gmelin.
Podiceps cornutus. Baird!

V. S. P. Bill shorter than the head, bluish black with a white tip; legs and feet brown pale anteriorly; irides red; orbits and rictus lake colour; eggs 3 to 4 white spotted brown.

Dorsal aspect. Crown of head, nuchal region and cheeks black, with a greenish iridescence; space between eyes and nostrils chesnut; upper part of the ruff commencing above the eye buffy orange, the remainder of the ruff black; interscapulary region and scapulars black, the feathers margined with whitish; great and small wing coverts and primaries clove brown; secondaries white; rump blackish brown.

Ventral aspect. Chin, upper part of throat, cheeks and auriculars glossy greenish black; lower part and sides of the throat glossy chesnut of a very deep tint; vent and tail coverts cinereous; flanks chesnut brown mixed with black; the remainder of this aspect glossy white sometimes tinged with yellow.

2nd primary longest; long scapulars longer than the primaries; length 16½ inches; alar expanse 19 inches; middle toe nail pectinate. The young bird is deficient in the ruff; its chin and cheeks with the ventral aspect is white; all the other parts except the secondaries are brownish cinereous. This young bird forms the *Podiceps obscurus et caspicus* of Latham and the *Colymbus nigricans* of Scop, and var. *A.* of Latham.

P. cristatus. Crested Grebe.
Colymbus urinator of Gmelin.
Podiceps cristatus. Baird!

V. S. P. Bill longer than the head about two inches, reddish white at the point; legs and feet blackish, interiorly yellowish white; naked space from the bill to the eye red; irides carmine; eggs 3 to 4 greenish white waved with deep brown.

Upper surface of head, occipital crest and lateral ruff, shining black; bases of the latter and sides of the nape tinged with rufous; back of neck, dorsal plumage and wings blackish brown; upper border of the wing tertiaries and all the secondaries, except 3 or 4 posterior ones, a spot before the eye, chin, sides of head and under plumage of the neck and body, white silvery below; length 23 to 24 inches. (Nuttall),—I have never met with the old bird, but a young bird beside me has the following distinctive characters:

Bill white, livid on the ridge; irides red.

Dorsal aspect. Crown of head, occipital crest, nuchal region, lower half of the neck on the sides, interscapulary region, rump, scapulars and wing coverts, including the primaries, cinereouss brown; secondaries white, as well as a space between the nostrils and orbit; chin, upper half of the throat, front of the remaining half, and remainder of ventral aspect, including the shoulders white; silvery on the belly and breast; the white is tinged on the flanks with cinereous; the ruff is wanting, but the occipital crest is present.

1st and 2nd primaries subequal and longest; long scapulars equal to the primaries; length 22 inches; alar expanse 28 inches; length of bill from the angle of the mouth 2½ inches.

P. minor. Little Grebe.

V. S. P. Bill short, strong, compressed, black, with the base of the lower one, white in the adult; ridge brown, sides and lower one yellowish in the young bird; legs and feet greenish brown externally, flesh colour internally; irides reddish brown, dark brown in the young; eggs 5 to 6 dirty white.

Dorsal aspect of a young bird after its first month as it lies before me: Crest wanting; crown of head brown, varied with yellowish brown; nape of neck and dorsal region including the primaries and rump blackish brown with olivaceous reflections, which are wanting in the primaries; secondaries white on the inner vanes and at the base.

Ventral aspect. Chin and middle of the breast and belly white; cheeks and sides of throat white tinged with rufous, and with irregular streaks and bands of the latter colour; upper part of the breast and sides banded with rufous brown and black, in which faint white streaks may be discerned; sides of belly and flanks blackish ash.

2nd primary longest; 1st and 4th subequal; long scapulars longer than the longest primary; length 11½ inches; alar expanse 16 inches; length of the bill from the angle of the mouth 1 inch and 2 lines.

P. rubricollis. Red necked Grebe.
Colymbus rubricollis et subcristatus of Gmelin!
Podiceps grisedgena. Baird!

D. C. Bill as long as the head, black, yellow at the base, from

the front to the tips $1\frac{1}{2}$ inches; irides reddish brown; legs and feet black, internally yellowish green; eggs 3 to 4 whitish green, soiled with yellowish brown.

Adult with the cheeks and throat ash colour, neck and breast rufous; crown and nape with a narrow black space, a short occipital black crest, but no ruff; front black; secondaries white; young duller coloured and spotted; no occipital crest; cheeks and throat white, the former striped with black. This bird will likely be found in this district, but I have not hitherto met with it.

P. Carolinensis. Red bill Dobchick or Grebe.
Colymbus podiceps of Gmelin!
Colymbus Ludovicianus of Catesby!

V. S. P. Bill pale with a black band across the centre including the nostrils; legs and feet blackish brown; irides hazel; eggs unknown.

Dorsal aspect. Crown of head and nape of neck blackish ash colour mixed with cinereous; dorsal region, rump, and scapular olive brown; great and small wing coverts, primaries and outer vanes of secondaries brown; inner vanes of secondaries white; cheeks and sides of the neck ashy.

Ventral aspect. Chin and orbicular space down the throat jet black; the remainder of the throat, its sides, and the cheeks as far as the nuchal region cinereous mixed with white; breast and its sides blackish brown, the feathers broadly tipped with soiled yellow; belly and sides glossy white, internally cinereous; the latter colour visible through the white vent and flanks, glossy blackish brown.

2nd primary longest; 1st shorter than the 3rd but longer than the 4th; length $13\frac{1}{2}$ inches; alar expanse $16\frac{1}{2}$ inches; length of bill from the angle of the mouth $1\frac{1}{4}$ inch. In the young bird the transversal band of the bill is obsolete or at most very faintly delineated; the chin is white, the breast and flanks light chesnut brown, and the belly silvery white tinged with brown. The inner and middle toes of the bird are connected beyond the first articulation, and the outer and middle toes are subequal in length.

Sub genus Colymbus.

Sub gen. char. Bill longer than the head, stout, straight, subcylindrical, compressed, with a subulate tip; nostrils basal, lateral, oblong, semiclosed by a membrane; feet placed far back; tarsus

compressed; anterior toes wholly palmated; hind toe small, barely touching the ground; wings moderate, small and acuminate; 1st and 2nd primaries longest; tail short, composed of 12 or 10 feathers. This genus appears to be the last of a connecting link between the true palmipedes and those whose toes are free. Their acuminate bill approximates them to the latter, while their really webbed feet induces us to classify them among the former. In general systematic works they have obtained a station after the Duck tribe; unjustly so; Cuvier's arrangement is decidedly the best, ranking them in their present position, which I have adopted.

C. Septemtrionalis. Red throated Diver.
C. striatus
C. stellatus } Young bird in its different states.
C. borealis
C. Septemtrionalis. Baird!

V.S.P. Bill black; tip brown colour; legs and feet blackish green; irides red; eggs 2, of a pale oil green colour.

Dorsal aspect. Crown of head, cheeks and sides of neck lead colour, approaching to black in the centre of the crown; a stripe along the back of the neck, branching off to the sides of the neck, black streaked with white; interscapulary region and scapulars black, with a couple of faint white spots on the tip of each feather; rump and tail black; great and small wing coverts brownish black; primaries and secondaries black, tipped with green brown and white on the inner borders at the base.

Ventral aspect. Chin lead colour; throat with a mesial line of deep purplish red; breast, belly, vent and tail coverts white; sides of flanks streaked with black; inner wing linings white.

1st primary longest; scapulars short; length 31 inches; alar expanse 37 inches; length of bill from the rictus 3 inches 1 line; the lower mandible is navicular; the upper one is about a line longer than the lower; the ridge of the upper mandible is inclined to yellowish brown in the specimen before me, and an irregular streak of white runs along the side of the lower one.

A female shot in the Lachine rapids in the spring of 1837 and in my possession has the following distinctive characters:

Dorsal aspect. Crown, nape of neck cinereous; dorsal region including the scapulars dark ash colour with a couple of white streaks on the tip of each feather, giving this region a crossed or zigzag appearance; rump and tail blackish ash; primaries black, as

well as the secondaries, white on the inner vanes towards the base.

Ventral aspect white; sides of flanks streaked with black. In another female, probably a younger bird, the anterior part of the throat and cheeks is mixed cinereous and white, imparting a grey or hoary appearance to these regions. The length of the latter specimen is 27 inches, that of the former 28 inches. Nuttal gives as the length of the male bird 29 inches. The stuffed specimen of the male, the description of which is given above, measured as stated 31 inches, probably owing to an irregularity in the manner in which the specimen has been set up. The bird is a rare one in our markets. The male specimens are even rarer than the female.

C. glacialis. Loon or Great Northern Diver.
C. immer of Gmelin! Young bird.
Colymbus torquatus. Baird!

V.S.P. Bill, legs and feet black; irides red; eggs 3 to 4 smoky olive, blotched with umber brown.

Dorsal aspect. Crown, cheeks, chin and whole neck jet black, deep black on the head, glossy at the lower part of the neck, with a purple reflection; on the front of the neck, a narrow band, scarcely reaching the sides, and about two inches below it, a collar commencing broadly behind and narrowing to the front, white, with broad longitudinal black lines, the black streaks occupying the centre of the feathers; interscapulary region, scapulars, great and small wing coverts; rump and tail coverts, black, verging to brown on the coverts, with rows of white spots; these spots being square and in pairs on the scapulars; suborbicular and in pairs on the dorsal region, and single and round on the coverts and rump; primaries, secondaries and tail blackish brown, white on the inner vanes of the two former near the base.

Ventral aspect. Shoulders white, streaked with black, like the collar; wing and tail coverts, and breast and belly white; sides and flanks black, streaked and spotted with white.

1st primary longest; length 34 inches; alar expanse 51 inches; length of the bill from the rictus 4¾ inches. The female is in every respect analogous to the female of the *C. Septemtrionalis*, but on a larger scale; the feathers of the head and neck of this bird are uncommonly velvety in feel, and from its approximation to the characters of fur and from its durability is often used for the same purpose by our Aborigines. The *C. Arcticus*, the

only other species of this genus met with on this continent does not visit us. It is a peculiarly northern sea bird, never met with beyond the sea coasts.

Fam. II. Longipennes.

Genus Sterna.

Gen. char. Bill as long or as longer than the head, compressed, slender, more or lest acuminate with sharp edges; upper mandible, curved at the tip, never hooked, and equal in length to the lower; nostrils in the middle of the bill, longitudinally cleft and pervious; legs and feet slender and small, with a naked space above the knee; tarsus shorter than the middle toe; the 3 front toes webbed; hind toe very short barely touching the ground; wings long, acuminate; 1st primary longest; tail of 12 feathers long and forked.

S. Hirundo ? The Great or Common Tern.

V.S.P. Bill fine orange, faintly delineated with black, near the tip, which is pale lake; irides deep hazel; legs and feet black.

Dorsal aspect. Crown, occiput, including the eye, black, descending for a short distance down the nuchal region, the remainder of which, with the rump and tail, is white; mantle pearl colour; the three first primaries greyish black, the others hoary pearl colour, all of them with a faint streak of white, running longitudinally along the inner vanes; shafts white; lower eyelid white.

Ventral aspect white.

1st primary longest, the others graduated; the tail moderate furcate; length from the lateral tail feather to the tip of the bill 20 inches; alar expanse 46 inches; the specimen a female. length of bill from the rictus $3\frac{1}{2}$ inches; length of the tarsus $1\frac{2}{3}$ inch. This bird differs in several particulars from the *S. Hirundo* of Nuttall, so much so that I feel almost inclined to rank it a separate species, were it not for the risk of multiplying species. The points in which they differ are the following:

S. Hirundo.	*S. Hirundo ?*
Crown and occiput wholly black, including the eyes.	Crown and occiput wholly black including the eye, lower eyelid white.
Mouth bluish white or pale lead colour.	Mouth pearl colour.
Tail greatly forked.	Tail moderately forked..

Bill reddish yellow or crimson tipped with black.	Bill orange, with a faint streak of black on both mandibles near the tip, which is pale.
Tarsus red, 1 inch long.	Tarsus and web black, the former $1\frac{2}{3}$ inch long.
Length 15 inches; alar expanse 30 inches.	Length 20 inches; alar expanse 46 inches.

From this comparative view of these two birds, there can be little doubt but that they are distinct. Under present circumstances, however, I do not wish to establish a new species, for they are sufficiently numerous; I much rather prefer ranking it under the head of *S. Hirundo* with a point of interrogation after it, thus implying my doubt as to its being in reality the bird mentioned by authors under that name. The specimen from which my description is taken is in the Museum of the Natural History Society of Montreal. This bird differs also very materially from the *Sterna Boysii.*

S. arctica. Arctic Tern.
S. argentea of Brehm!
S. macroura of Newman.
Sterna macroura. Baird!

V.S.P. Bill orange tipped with black; legs and feet scarlet; irides brown; eggs 2 to 3, light yellowish brown or bluish grey potted irregularly with brown.

Dorsal aspect. Crown and nuchal region jet black; mantle pearl grey; rump and tail coverts white; outer vane of the 1st primary black; outer vanes of all the others, as well as the tips, and a stripe down the inner vanes along the shafts, hoary grey, verging to black at the tips; outer vane of the lateral tail feathers black; of all the others pearl grey; inner vanes of primaries, secondaries, and tail feathers white.

Ventral aspect. Cheeks, throat, vent, tail coverts, and wings linings pure white; all other parts pearl colour.

1st primary longest; wings extending long over the tail; length 14 inches; alar expanse 30 inches; length of the bill from the rictus 1 inch 9 lines; tarsus and toes small; middle toe, without the nail, equal to the tarsus. In two other specimens before me, the new lateral tail feathers only have their external vanes pearl grey, and not black at all, and all the other tail feathers white. This Tern is the most common one in this district.

S. nigra. Black Tern.
S. fissipes of Gmelin !
S. obscura of Latham !
S. plumbea of Wilson !

V.S.P. Bill black, pale towards the base of the lower mandible; legs and feet brown or purplish black; irides brown; eggs 3 to 4 olive brown, mottled brown, and black.

Dorsal aspect of the young bird. Frontlet ashy white; crown and nape blackish ash; interscapulary region and scapulars dark ash, tipped with rufous white; wings, rump and tail pale ash; the former with a narrow edging of white on the inner vanes; crescent in front of the eyes, and auriculars black.

Ventral aspect. Throat and its sides, chin, middle of the breast, belly, tail and wing coverts white; sides, flanks, and axillaries pale ash; shafts of all the wings and tail quills black.

1st primary longest; wings extending about $1\frac{1}{2}$ inch beyond the tail which is subfurcate; length $9\frac{1}{2}$ inches; alar expanse 20 inches; middle toe, without the nail, longer than the tarsus.

The adult plumage in nuptial dress: coverts of wholly blackish ash; the winter dress of adult birds is lead colour, with the head and neck deep black, and the front, throat and vent white. This bird is not often met with in this district.

Genus Larus.

Gen. char. Bill moderate, rather stout, straight, compressed, naked at the base, with sharp incurved edges; upper mandible rounded above with the apex curved; lower one shorter, gibbous and angular beneath the point which is blunt; nostrils medial, lateral, longitudinal and open; tail slender; thumb small, not touching the ground; hind nail occasionally wanting; wings long and acute; 1st and 2nd primaries subequal and longest; tail, more or less square, of 12 feathers.

L. atricilla. Black headed Gull—Laughing Gull.
L. ridibundus of Wilson !
Chroicocephalus atricilla. Baird !

V.S.P. Bill, legs and feet red; irides hazel; eggs 3 olive grey, spotted, pale purple, and dilute brown.

Mantle dark bluish ash, quills black; above and below the eyes a spot of white; eyelids and sides of the mouth lake red; head and neck black; the whole ventral aspect white; 5 first primaries black towards their tips and except the 1st and 2nd tipped

with white, the secondaries broadly so; the closed wings extending two inches beyond the tail. In winter, the hood is wanting, and the young birds have a subterminal band of black on the tail, while their dorsal and ventral aspects are brownish, tipped with rusty white. Length of an adult 17 inches; alar expanse 36 inches. A specimen of this bird is in the Museum of the Natural History Society; it is a rare one in this vicinity.

L. tridactylus. Kittiwake Gull.
L. rissa of Pennant!
L. rissa tridactyla. Baird!

V.S.P. Bill of the old bird yellowish; of the young bird black, brownish at the base; legs and feet yellowish, (black according to Nuttall); orbits orange; irides hazel; eggs 3, olivaceous white spotted light and dark grey.

Old bird summer plumage. Mantle bluish grey; 5 exterior quills and outer web of 1st black; 4th and 5th tipped with white; all the other parts white. In winter plumage, the occiput and neck are French grey, and the rictu-orbital space streaked with black. A young bird before me presents the following characters:

Crown of head, occiput, and scapulars grey skirted with brownish white; rump and wing coverts, except the upper row of the small wing coverts which is brownish black, bluish ash colour; tail white with a subterminal band of black, and tipped with white; all the primaries black towards the extremities, the black running down the outer and inner margins in a narrow streak; the whole outer vanes of the 1st primary black; all the primaries except the 1st tipped with white; auriculars brown.

Ventral aspect white.

1st primary longest; length 14 inches; alar expanse 30 inches; the tarsus and web have dried pure white, so that I doubt very much whether a black colour, as given by Nuttall, could even characterize this part in the young bird. I have never met with an old specimen.

L. canus. Common Gull or Mew.

V.S.P. Bill yellow; legs and feet blackish grey, blotched with yellow on the webs; irides hazel; eggs 3, bluish or ochraceous, spotted with cinereous and blackish.

Summer plumage. Mantle bluish grey; the first six primaries with black near the tips, forming a narrow bar on the 6th; the

1st and 2nd with a long white space near their tips; all the others including the scapulars and secondaries broadly tipped with white; all the other aspects white.

In winter plumage, the head and neck are spotted with black and the young is brownish cinereous varied with rusty.

Length 19 inches; alar expanse about 36 inches.

L. fuscus. Silvery Gull.

V.S.P. Bill yellow, angle on the lower mandible lively red; legs and feet yellow; irides hazel; orbits red; eggs 2, olive brown or grey, blotched with dusky.

Winter plumage. Mantle slate black; 1st and 2nd primaries with an oval white spot; all the other parts of the quills black, except a white tip, which is also observable on the scapulars and secondaries; head and neck streaked with light brown; ventral aspect and tail white. In summer the head and neck are pure white, and the young bird is bluish grey, mottled with yellowish rusty.

Length 20 inches; alar expanse about 38 inches.

L. argentatus. Herring Gull.
L. argenteus of Brehm!
L. argentatus. Baird!

V.S.P. Bill and orbits yellow, the former with the angle of the lower mandible lively red; irides hazel; legs and feet flesh colour; eggs 2 or 3 olivaceous, spotted with dark cinereous.

Summer plumage of adult. Ventral aspect, head, neck, rump, and tail pure white; mantle bluish ash colour; primaries black towards their extremities; the first one with a spot of white near the tip, which is obsolete on the second; and all of them, as well as the secondaries and scapulars, tipped with white. In winter the head and neck are varied with brown lines. The young bird blackish ash, mottled with rusty.

Length 24 inches; alar expanse 50 inches. The female is about an inch shorter than the male. This gull is commonly met with in the autumn.

L. glaucus. Burgomaster.
L. glaucus. Baird!

V.S.P. Bill brown colour at the base, blackish near the tip; legs and feet flesh colour; irides dark hazel; eggs 3 pale purplish grey, spotted with umber brown and pale purple.

Summer adult plumage. Mantle bluish ash colour; quills greyish white; primaries, secondaries, scapulars, tipped with white; all the other parts white. In winter the head and neck are streaked and mottled with pale wood-brown. The young birds have longitudinal pale brown streaks on the head and neck, and the upper plumage transversely barred with ash grey and greyish yellow.

Length 29 inches; alar expanse 44 inches.

Fam. IV. Lamellirostres.

Genus Anas.

Gen. char. Bill broad and large, furnished on the edges with thin salient laminæ placed transversely; feet placed far back, not sufficiently so as to incapacitate them from walking, but so as to render them a weak and uneasy kind of waddle; their wings moderately long, and their tail more or less acute or round.

Sub genus Anser.

Sub gen. char. Bill short, thick, rather compressed, deeper than broad at the base, and depressed at the apex; marginal teeth short, conic and acute; nostrils lateral, medial, elliptical, large, open, pervious, covered by a membrane; tongue fringed on the sides, short and thick; 1st, 2nd, and 3rd primaries longest; tail rounded, of 16 to 20 feathers.

A. Canadensis. Canada Goose.
Bernicla (Leucoblepharon) Canadensis. Baird!

V.S.P. Bill, legs and feet black; irides reddish hazel; eggs 6 to 7 greenish white.

Dorsal aspect. Head and neck black; a spot on the brown eyelid, and a uniform patch from the auriculars, meeting its fellow on the chin, white; interscapulary region and scapulars dark brown, with pale edgings; secondaries and wing coverts pale brown; primaries and tail black; rump black; tail coverts white.

Ventral aspect. Lower part of the neck and sides greyish brown, with pale edges; centre of the breast and belly greyish white; vent, flanks, and tail coverts white.

2nd primary longest; 1st and 2nd subequal; length 37 inches; alar expanse 60 inches; length of bill from frontal feathers 2 inches and 2 lines; length of the middle toe and tarsus together 6½ inches.

A. hyperboreus. Snow Goose.
A. (*Chen*) *hyperboreus.* Baird!

D.C. Bill, feet and orbits deep or aurora red; irides dark hair brown; eggs yellowish white.

General colour white; quills pitch black, their shafts white at the base; head glossed with ferruginous, extending sometimes to the neck and even to the middle of the belly.

Length 32 inches; alar expanse 33 inches (Nuttall). This species and the two following are extremely rare in this district, being only birds of passage, through it, an occasional straggler only being killed. I never met with a specimen of this bird and I have never seen but a single specimen of each of the following:

A. leucopsis. Barnacle Goose.
Anas leucopsis of Linnæus!
Anas erythiopsis of Temminck!
Bernicla or *Clakis* of Latham!
Bernicla (*Leucopareia*) *leucopsis.* Baird!

D.C. Bill, legs and feet black; irides blackish brown.

Front sides of the head and throat pure white; a small stripe between the eye and bill, occiput, nape, neck, upper part of the breast, tail and quills black; feathers of the back scapulars and wings of an ashy grey from their origins, with a wide band of black towards their ends and all tipped with whitish grey; lower parts pure white, with the exception of the flanks which have a cinereous tint.

Length 25 to 27 inches (Nuttall).

A. bernicla. Brant or Brent Goose.
A. torquatus of Veillot!
Anas bernicla of Linnæus and Latham!
Bernicla (*Bernicla*) *brenta.* Baird!

D.C. Bill, legs and feet black, the former shorter than the head; irides hazel.

Head and neck with shoulders and breast greyish black; quills, tertiaries, rump and tail greyish black; back scapulars and outer and inner wing coverts clove brown, margined with yellowish grey; a mottled spot on the side of the neck; tail coverts above and below, sides of the rump and vent, white; belly yellowish grey; flanks narrowly barred with bluish grey and white; tail coverts as long as the tail, which is much rounded.

Length 24 inches; alar expanse 42 inches (Nuttall).

Sub-genus Cygnus.

Sub gen. char. Bill higher than broad at the base, gibbous, obtuse, and equally broad throughout; teeth lamelliform; nostrils central, oval, pervious, and covered by a membrane: tongue fringed at the sides; lores naked; neck long; feet placed far back; tarsus shorter than the middle toe; primaries and secondaries subequal in length; 2nd and 3rd longest; tail cuneiform.

C. ferus. Wild or Whistling Swan.
C. musicus of Bechstein and Buonaparte!!
Anas C. ferus of Linnæus!
Anas cygnus of Linnæus and Latham!!
Cygnus Americanus. Baird!

V.S.P. Bill black; care and space round the eyes yellow; irides dark hazel; legs and feet black; eggs 5 to 7 olivaceous, green and rough.

Dorsal and ventral aspects. White, except the crown of head and neck, which are more or less tinged with yellowish.

The young bird is pale grey, with a dull black bill and a livid care, and reddish grey feet.

Length of a specimen killed opposite Longueuil, and at present a conspicuous object in the Museum of the Natural History Society, 66 inches; alar expanse 90 inches; length of the bill from the frontal feathers 4 inches, 10 lines: do of tarsus and middle toe with nail 11¾ inches. The specimen alluded to is the only one of the species known at present to have been killed in this District. It is an extremely rare bird. I do not think that the *C. buccinator* has ever been met with here. The specimen in the Natural History Society has the frontal feathers only tinged yellow.

Sub genus Anas.

Sub gen. char. Bill broader than deep at the base, becoming slightly contracted, and then widening towards the tip, which is obtuse and flattened; marginal teeth lamelliform and weak; upper mandible entirely covering the under; nostrils basal, open, pervious, and covered by a membrane; tongue fringed at the sides; neck about the same length as the body; tarsus about equal to the middle toe; wings moderate, acute; 1st or 2nd primaries longest; tail rounded or cuneiform, composed of 14 to 16 feathers. In most species the lower row of wing coverts is very gaudily coloured, and extremely glossy, and is the part alluded to in the following description of the species under the name of "speculum."

A. boschas. Common Mallard.
A. domestica of Richardson and Swainson ! !
Boschas major of Ray !
Anas boschas. Baird !

V.S.P. Bill livid, the nail yellow (Bill wax yellow, Nuttall !); irides reddish brown; legs and feet orange; eggs 10 to 18 bluish white.

Dorsal aspect. Head and neck rich glossy emerald green; collar white, interrupted on the nape of neck; interscapulary region light chesnut brown with paler edgings; shoulders and scapulars whitish grey, elegantly undulated with clove brown; the exterior row tinted with rich chesnut; small wing coverts greyish brown, the outermost ones margined with white; speculum rich glossy purple, with a deep sea green iridescence, and bounded above and below with jet black and white; rump and tail coverts, black, with a deep emerald green iridiscence; the two central tail coverts recurved; tail composed of 16 feathers, brown in the centre along the shafts, broadly margined with white; the feathers acuminate; primary quills pure brown.

Ventral aspect. Chin and throat to the breast like the head; breast dark chesnut; wing linings and axillaries white; belly sides and flanks greyish white, finely undulated with clove brown; tail coverts velvet black.

2nd primary longest; length $23\frac{1}{2}$ inches; alar expanse 34 inches; length of bill from frontal feathers, 2 inches and two lines; length of tarsus, middle toe and nail together, 4 inches.

"The female and young are wholly brownish, varied with yellowish and bluish."

A. clypeata. Shoveller.
A. rubens of Gmel. ! var. young male !
Spatula clypeata. Baird !

V.S.P. Bill livid black; legs and feet orange; irides reddish brown (yellow ?) eggs 12 to 14, pale greenish yellow.

Dorsal aspect. Space in front of the orbits, frontlet and medial line to the interscapulary region, and interscapulary region umber brown, tinted with green on the head and margined with wood brown in the latter situation; cheeks and sides of the neck, dusky emerald green; lower half of the neck, short scapulars and sides of the rump, white; long scapulars, with the outer vane pale blue, and the inner vane white, margined with jet black, tinted

with green; small wing coverts pale blue; speculum brilliant grass green, bounded above and below with white; rump brownish black, tinted with sea green; tail coverts sea green; tail cuneiform; the four central feathers umber brown, all the others white, more or less spotted with brown; primaries umber brown, their shafts white.

Ventral aspect. Chin and upper half of throat umber brown; breast and wing linings white; belly, vent, and sides chesnut; flanks chesnut, finely undulated with dark brown; tail coverts black with a sea green iridescence.

2nd primary longest, 1st subequal to 2nd, the others graduated; length 20 inches; alar expanse 35 inches; length of bill from the frontal feathers $2\frac{2}{3}$ inches. The female is liver brown above, with broad borders of pale wood-brown—beneath, pale wood-brown with obscure livid brown marks; the lesser wing coverts are slightly glossed with pale blue, and the speculum is less vivid than in the male.

A. strepera. The Gadwell.
Chaulelasmus streperus. Baird!

D.C. "Speculum white bordered with black and chestnut; feet "orange; their webs blackish; tail of 16 feathers; male blackish, "waved with white; rump black. Female duller and rump uni-"form in colour with the rest of the plumage."

Length 23 inches; do of bill 1 inch 7 lines. I have no doubt that this species is to be met with in this District, but it has as yet escaped my notice.

A. obscura. Dusky duck—Black duck.
A. obscura. Baird!

V.S.P. Bill livid, its nail black; legs and feet yellowish; irides hazel; eggs 8 to 15, white.

Dorsal aspect. Crown of head blackish brown; frontlet streaked with drab; cheeks and sides of the neck drab, streaked with blackish brown; interscapulary region, rump, scapulars, and lower wing coverts umber brown, margined with pale chesnut; tail coverts black, margined with pale chesnut; tail cuneiform, blackish brown edged with brownish white; primaries dusky; speculum purplish green, bordered above and below with jet black, the lower border terminated by white.

Ventral aspect. Chin and throat drab, streaked with blackish brown; the remaining parts of this aspect umber brown, streaked

with chesnut in the centre of each feather on the breast, belly and flanks, and margined with pale chesnut in the two latter situations.

2nd primary longest, 1st next, the others graduated.

The female resembles the male.

A. discors. Blue Winged Teal.

Querquedula discors. Baird!

V.S.P. Bill livid black; legs and feet yellow; irides hazel; eggs.

Dorsal aspect. Crown of head and border of a crescentic white patch extending from the crown to the chin, between the orbits and bill, brownish black; cheeks, sides of the neck and nape greyish, with a lavender purple iridescence; interscapulary region and short scapulars umber brown, zigzag barred, and margined with cream colour; long scapulars striped with blackish green, pale blue, and deep cream colour, some of them wholly blue; rump umber brown with pale margins; lateral tail coverts blackish green, centre ones wood-brown; tail subrotund with acuminate feathers which are umber brown with pale margins; small wing coverts pale blue; upper row of great wing coverts blackish brown at their bases, with white distal halves; speculum dark green; primaries umber brown, pale on their inner vanes.

Ventral aspect. Chin and upper half of the throat like the cheeks; remainder of the throat, breast, belly, vent, sides and flanks, pale chesnut, with orbicular black spots on the breast and sides, and black bars on the belly and flanks; sides of the rump white; under tail coverts umber brown; axillaries white.

1st primary longest; length 16 inches; alar expanse 23½ inches; length of bill from the frontal feathers to the tip 1 inch 9 lines; length of tarsus, middle toe and nail 3 inches.

The female wants the white patch on the rump, and the crescent before the eye, and the purple iridescence on the head and neck. Her long scapulars are uniform in colour with the rest of the interscapulary region, and her ventral aspect has the chesnut tinge less developed, and irregularly blotched with black. The young birds are deficient in the green speculum, but resemble the mother in other respects.

A. crecca. American Teal.

Nettion crecca. Baird!

V.S.P. Bill bluish black; legs and feet reddish grey; irides hazel; eggs dusty white spotted with brown.

Dorsal aspect. Crown of head, cheeks, and sides of the neck glossy chesnut; encircling the eye and proceeding backwards from it a glossy emerald green band bordered inferiorly by black, and then faintly with white; nuchal crest indigo blue; lower part of the neck white, elegantly waved with fine lines of brownish black; interscapulary region and rump pale brown or ash, finely waved with white near the tips of the feathers; long scapulars and small wing coverts ash colour, outer ones bordered on their outer vanes with jet black; short scapulars finely waved with white and blackish brown; tail coverts black, margined with cream colour, the lateral ones having a deep purple iridescence; quills of the tail and primaries dusky, the former having pale edges; speculum glossy grass green, bounded superiorly by brownish white, inferiorly by white, and on either side by jet black; the shoulder with a crescentic white band.

Ventral aspect. Chin brownish black, remainder of the throat half chesnut and half white, waved with brownish black; breast wood-brown with semi-orbicular black spots; belly and vent white glossed with wood-brown; sides and flanks white, waved with blackish brown; lateral tail coverts white, glossed with wood brown, central ones jet black, the long ones of which are edged with white.

1st primary longest, 2nd subequal to it, the rest are graduated in respective lengths; length 15½ inches; alar expanse 23 inches; length of bill from frontal feathers 1 inch and 4 lines; length of middle toe, nail, and tarsus 2½ inches.

The female wants the crest, the brilliant colours on the head, the stripes on the scapulars, the black under tail coverts, the orbicular spots on the breast, and the wavy markings on the back and sides. In lieu of which her dorsal aspect is liver brown with pale margins, and her chin and belly white, the latter marked with brown. (Nuttall.)

A. Americana. American Widgeon.
Mareca Americana.
Mareca Americana. Baird!

V.S.P. Bill bluish grey on the upper mandible, which is tipped with black; lower mandible wholly black; legs and feet red; irides hazel; eggs 6 to 8.

Dorsal aspect. Front and crown to the occiput white; a patch on the side of the head, including the orbits, and proceeding backwards to the nuchal crest, black, with a bronzy and sea green

iridescence, and irregularly barred with white; space before the orbits, remainder of the cheek and sides of neck, white, barred with dull black; on the cheeks the white is tinged with yellow; interscapulary region and scapulars elegantly waved with fine lines of black, reddish brown, and white, the last colour only met with on the outermost of the short scapulars; long scapulars half velvet black, with a green reflection and half clove brown, bordered on the outer vane with white, with shafts of the same colour; rump clove brown with cinereous margins, finely waved with white; tail coverts black, margined on the inner vanes with white; tail cuneiform; the two long central feathers hair brown, the lateral ones cinereous, margined and tipped with white; primaries clove brown, pale in tint on the inner webs; small wing coverts crimson; speculum velvet black, inferiorly green above, bordered superiorly with black and internally with crimson white.

Ventral aspect. Chin blackish brown spotted with white; upper part of throat cream colour, minutely spotted with black, remainder of throat white, spotted black; breast and sides reddish brown, with a shining grey gloss to the feathers; belly, vent and sides of the rump white; femorals greyish white finely waved with brown; under tail coverts jet black, the centre ones brown tipped with white.

1st primary longest, the others graduated; the longest scapular subequal to the 6th primary; length 21½ inches; alar expanse 32 inches; length of bill from the frontal feathers 1 inch 8 lines. In the female, the dorsal aspect is liver brown, edged and barred with pale brown and white; the bronzy green iridescence on the head is wanting, and the tail is more rounded.

A. acuta. Pintail duck.

A. caudacuta of Richardson!

Dafila acuta. Baird!

V.S.P. Bill livid with a black ridge; legs and feet grey; irides reddish hazel; eggs, 8 to 9, greenish blue.

Dorsal aspect. Crown and front, with the occiput, umber brown, with pure brown edgings; cheeks and sides of the neck hair brown with a lavender purple iridescence on the side of the neck below the occiput; nuchal region blackish brown, divided from the hair brown side of the neck by a white stripe, which runs up from the lower half of the throat to near the occiput; anterior part of the back, interscapulary region, short scapnlars and rump white, beautifully waved with transverse lines of black; long scapulars black-

ish green with cinereous borders, the outermost ones striped with white; short tail coverts brownish white, with a brown streak along the shaft; long coverts blackish brown on the outer vanes, brownish white on the inner vanes; wing coverts cinereous; primaries and tail quills clove brown; the shafts of the former white, and the outer vanes of the former edged with brownish white; the two long central feathers blackish green, extending more than two inches beyond the longest of the other feathers of the tail; speculum bronzy green bounded above by ferruginous, and below by white.

Ventral aspect. Chin and upper half of the throat umber brown; remaining half, breast, and belly white; sides and flanks white, waved with black like the back; vent white, minutely sprinkled with grey; sides of the rump cream white; tail coverts jet black, half of the outer vanes of the outermost ones white.

1st primary longest; 2nd subequal; length 29 inches; alar expanse 36 inches; length of bill from the frontal feathers, 2 inches and 2 lines. In the female the two long tail feathers are wanting, together with the wavy flanks and sides, and the speculum wants the bronzy gloss; her dorsal plumage is brownish black, with a spot on each side of the shaft, with borders of reddish white. The speculum is wholly deficient in the young bird.

A. sponsa. Wood duck.
Dendronessa sponsa of Richardson and Swainson!
Aix sponsa. Baird!

V.S.P. Bill red, a stripe on the ridge, its tip and its margins black; lower mandible wholly black; legs and feet orange; irides red; eggs 12 to 13 yellowish white.

Dorsal aspect. Crown of head and space round the eyes deep sea green; a stripe from the projecting base of the bill to the crest, and another from above the auriculars to the crest white; the iridescence from the eye to the crest is bronzy, and on the cheeks purple and reddish purple; a crescent from the auriculars to the chin, and another on the side of the throat, white, below which crescents the plumage is deep purplish black; nuchal crest, composed of bronze, deep purple, purplish red, sea green, and white hair like feathers; interscapulary region and rump bronze; tail coverts bronzy green, the lateral ones hanging gracefully over the side of the tail in a hair like manner; short scapulars jet black, with a faint bronzy reflection; long scapulars half black, and half bronzy green; long scapulars half black and half purple;

wing coverts cinereous, the lower internal ones with a purplish iridescence; speculum purplish blue, tipped inferiorly with white, and bordered internally with bronze; tail feathers blackish green, the form of the tail round; primaries hoary white on the outer vanes; clove brown on the inner vanes, which are also tipped with purple.

Ventral aspect. Chin and upper half of the throat white, remainder of the throat and breast bright glossy chesnut brown with terminal triangular spots of white; belly and vent white; shoulders with a crescent of white, the feathers of which are broadly tipped with jet black; sides yellowish brown, elegantly waved with blackish brown; flank yellowish grey finely waved with black, the tips of the long feathers broadly barred with white and black; sides of the rump purplish red; axillaries white, barred with blackish brown; tail feathers bronze; inner aspect of the wings cinereous.

2nd primary longest; 1st longer than the 3rd; length 20 inches; alar expanse 28 inches; length of bill from frontal feathers 1½ inch.

The female has the head and crest and a white patch round the eye brownish; the wavy lines on the flanks and the pendant tail coverts are wanting; the crest is shorter, and on the whole the plumage is less vivid.

Sub-genus Clangula.

Sub-gen. Char. Bill short, narrow at the base, not much elevated, slightly curved or scolloped from the base to the curve at top; nostrils suboval and subcentral; tail moderately long.

A. albeola. The Spirit duck.
Clangula albeola. Richardson and Swainson!
Fuligula albeola. Bonaparte!
Anas bucephala of Pennant!
Bucephala albeola. Baird!

V.S.P. Bill blueish black, yellowish at the tip; legs and feet yellow; irides yellow; eggs unknown.

Dorsal aspect. Crown of head and sides of neck glossy reddish purple; front, cheeks, and lower part of crest on the nuchal region, dark green; a broad band from the eye to the occipital crest, and lower part of the neck at its sides and back, white; interscapulary region, long and inner short scapulars, rump, and primaries, black; outer scapulars, and outer wing coverts, white,

the former fringed with black; speculum white; tail coverts blackish grey; tail hoary blackish grey, edged with brownish white.

Ventral aspect. Chin and upper half of the throat splendent reddish purple; lower half of the throat, breast, sides, and flanks, white; belly, vent, and tail coverts, glossy greyish white.

1st and 2nd primaries subequal and longest; length 19 inches; alar expansion 20 inches; length of bill from the frontal feathers 1 inch and 1 line; length of tarsus, middle toe and nail, 3 inches 4 lines.

The female is smaller. Head and dorsal plumage dark blackish brown; fore part of back, scapulars and tertiorus edged with yellowish brown; fore part of neck, sides, flanks, and vent, blackish grey; breast and belly white, glossed with browish orange; lower coverts blackish brown. The young males resemble the females. "Individuals vary much in size." Nuttall. This bird is not uncommon, and it is without exception one of the loveliest of the tribe met with in this district. None of them are more difficult to kill on the water, diving with the greatest rapidity on the least noise, whether from the pull of the trigger or other causes.

A. clangula. Golden eye.
A. glaucyon. Young bird of Pennant!
Fuligula clangula of Bonaparte!
Clangula vulgaris of Leach and Fleming!
Bucephala Americana. Baird!

V.S.P. Bill black; legs and feet orange yellow; irides golden yellow; eggs 7 to 10, white.

Dorsal aspect. Frontlet dull blackish brown; crest, crown, nuchal region, cheeks, and sides of neck, splendent dark green; lower half of the neck white; interscapulary region, long scapulars, outer wing coverts, rump, and primaries, black; long outer scapularies white; outer short scapulars white, with a streak of black; inner wing coverts and speculum, white; tail coverts black; tail hoary greyish black. A round patch before and below the eye, and at the base of the bill, and a spot on the auriculars, white.

Ventral aspect. Chin, and upper third of the throat, blackish brown; remainder of throat, breast, belly, and sides, white; vent feathers greyish black, tipped with white; tail coverts greyish

black, broadly margined and tipped with white; flank feathers white, margined with jet black on the upper vanes.

2nd primary longest; 1st next; length 22 inches; alar expanse 29 inches; length of bill from the frontal feathers, 1 inch 4 lines. The female resembles that of the *A. albeola.* The white patch in the cheek does not make its appearance until the second year. The trachea of this species presents a singular conformation in the male.

A. histrionica. Harlequin duck.
Fuligula histrionica. Bonaparte!
Clangula histrionica of Leach, Richardson, and Swainson!
Histrionicus torquatus. Baird!

V.S.P. Bill bluish black, orange red at the tip; legs and feet blackish brown; irides hazel; eggs 12 to 14, white.

Dorsal aspect. Space between the eye and bill, a spot on the auriculars, a streak on each side the nuchal region, collar at the base of the neck, a transverse stripe on the shoulders, the outer vanes of the scapulars, white; a stripe from the base of the bill to the occiput bluish black, bounded on the sides by a stripe of chestnut, commencing over the eye, and meeting on the occiput; the remainder of the head and neck dark plumbeous blue; commencement of back and shoulders dull blue; interscapulary region, rump, and wing coverts, blackish brown; tail coverts blackish green, as well as the speculum; tail acuminate, hoary blackish brown; primaries blackish brown; the white on the shoulders bounded by black.

Ventral aspect. Chin and throat bluish black; breast bluish slate colour; belly, vent, and tail coverts, dark blackish brown; sides and flanks chesnut, faintly barred with black; sides of the rump bluish black.

1st primary longest, the others graduated; length 18½ inches; alar expanse 26 inches; length of bill from the frontal feathers 1 inch 1 line; length of the middle toe, tarsus and nail, 3½ inches.

Sub-genus Oidemia.

Sub-gen. Char. Bill broad; gibbous above the nostrils, with dilated margins; teeth lamelliform and coarse; nostrils central, large, oval; tail short for the size of the bird.

A. perspicillata. Black or surf duck.
Fuligula perspicillata of Bonaparte!
Oidemia perspicillata of Richardson and Swainson!
Pelionetta perspicillata. Baird!

D.C. Bill reddish orange; the nail paler; a square black spot on the lateral protuberance; legs orange; the webs blackish brown; irides yellow; eggs 4 to 6, white.

Dorsal and ventral aspect. Velvet black, with a reddish reflection; a broad white band between the eyes, and a triangular patch of the same on the nape; throat brownish; no speculum; female sooty brown, whitish near the bill and auriculars.

Length 24 inches; the wing $9\frac{1}{2}$ inches; the bill above, 1 inch $4\frac{1}{2}$ lines; tarsus 1 inch 3 lines. This bird is occasionally met with. A specimen exists in the museum of the Natural History Society.

A. fusca. Velvet duck.
Fuligula fusca of Bonaparte!
Oidemia fusca of Richardson!
Melanetta velvetina. Baird!

V.S.P. Bill, protuberance, posterior part of the upper mandible, margins, and a spot at side of the tip, black; the rest orange; legs scarlet, with black webs; irides pale yellow; eggs 8 to 10, white.

Dorsal aspect. Blackish brown, of a velvety hue and feel; a crescent of white on the lower eyelid, extending behind the eye; speculum white.

Ventral aspect. Throat and breast blackish brown, and velvety like the back; belly, vent, and sides, sooty brown,—brightest on the sides.

1st primary longest; length $24\frac{1}{2}$ inches; alar expanse 38 inches; length of bill from the frontal feathers, and along the protuberance, 1 inch 10 lines; from the rictus to the tip 2 inches and 10 lines.

A young bird in the museum of the Natural History Society is wholly sooty brown, with greyish white on the auriculars, lower eyelid, and on the toes. It measures $21\frac{1}{2}$ inches long, and its bill is wholly black, and the protuberance but very slightly elevated. This bird is common in the spring of the year.

Sub-genus Harelda.

Sub gen. Char. Bill short, tip much arched, high at the base; laminæ distant, prominent, and cutting, lower ones divided into

two rows; nostrils sub-basal, large, and oblong; tail long and tapering.

A. glacialis. Long-tailed duck.
Harelda glacialis of Richardson and Swainson!!
Fuligula glacialis of Bonaparte!
Anas caudacuta harelda of Ray!
Harelda glacialis. Baird!

V.S.P. Bill black, with an orange transversal band near the tip; legs and feet dusky; irides red, approaching to hazel; eggs 5, pale greenish grey.

Dorsal aspect. Frontlet, crown, and cheeks, dusky drab,—lightest on the crown, and darkest on the cheeks; auriculars black, this colour descending down the sides of the neck in the form of an irregular broad patch; remainder of the neck to the interscapulary region white; interscapulary region, rump, and wing coverts, shining black; long and short scapulars ashy white, the long scapulars hanging gracefully over the wings; four central tail feathers black, and very long; the four adjoining ones on each side cinereous along the shafts, broadly margined with white, the other lateral ones wholly white; central tail coverts black; lateral tail coverts white on the outer vanes, and black on the inner vanes; primaries blackish brown, secondaries brown, the tips of the latter forming a shining brown speculum.

Ventral aspect. Chin and throat white; breast and half of the belly black; remainder of the belly, vent, and sides of the rump, white; sides and flanks greyish.

2nd primary longest; 1st next. and subequal to the 2nd; length 23 inches; alar expanse 29 inches; length of bill from the frontal feathers 1 inch and 2 lines.

The female has the tail short; a spot on the throat and eye-bands, white; crown of head blackish; breast varied with ash and brown; and the feathers of the back black, margined and tipped with ashy rufous; the irides pale brown. "Nuttall."

Sub-genus Fuligula.

Sub-gen. Char. Bill long, broad and flat, gibbous at the base, and more or less dilated at the extremity; nostrils basal, oval.

A. ferina. The Pochard, or Red-headed duck.
Fuligula ferina of Stephens!
Aythya Americana. Baird!

V.S.P, Bill greyish blue, with a black tip; legs and feet black; irides reddish hazel; eggs 12 to 13, greenish white,

Dorsal aspect. Whole head and two-thirds the neck rich chesnut, with a reddish iridescence; remainder of neck and commencement of back, with the shoulders, black; interscapulary region, rump, and short scapulars, finely zigzag waved with clove brown on a white ground; inner long scapulars grey, with a reddish iridescence; outer margin of the external long scapulars black; tail coverts blackish brown; tail hoary greyish ; wing coverts grey, faintly sprinkled with white; primaries pale grey, tipped with clove brown, which is also the colour of the outer vane of the two first primaries; speculum whitish grey, fringed with white inferiorly,

Ventral aspect. Chin and throat like the dorsal aspect; remainder of the throat and breast black, fringed with white as it approaches the belly; belly pure white; vent white glossed with chesnut, and with faint wavy lines of grey; tail feathers brownish black; sides and flanks waved with clove brown on a white ground.

1st primary longest; length 21¼ inches; alar expanse 30½ inches; length of bill from the frontal feathers 2 inches 1 line. The bill of this bird is recurved.

The female is liver brown, with pale edgings, and the chesnut of the head is margined with yellowish brown. The white of the ventral aspect is tinted with grey.

A. Labradorica. Labrador duck.

Fuligula Labradorica. Anderson!

Camptolæmus Labradorus. Gmel.! Gray! Baird!

V.S.P. Cire flesh colour; remainder of bill blackish horn colour; tarsi and irides yellow.

Dorsal aspect. With the exception of a streak of black stretching from the base of the bill to the occiput, and a very light brown streaky stain stretching from the cire to below the ear, all the rest of the head, with the secondaries, pure white; remainder of the back black; tail, which is rather acuminately rounded, blackish brown; the distal third of the outer edge of the outer scapulars coloured with black, and the whole of the inner vanes of the inner half dusky, terminating in blackish, giving to the under surface of the wing a dusky appearance; the primaries are all dusky black; the feathers on the cheek have a bristly feel; in other parts of the head and neck the feathers have a velvety feel, a good deal resembling that of the Great Northern Diver.

Ventral aspect. A belt of white across the breast until it touches the wing, and separated from the white of the head by a ring of black about half an inch broad; remainder of breast black, quickly changing to blackish, which itself changes to brown on the abdomen and under wing coverts; the flanks, like the lower part of the breast, are shining black.

Length, from tip of bill to apex of tail, 20½ inches; alar expanse 27½ inches; the two first primaries longest and subequal.

A specimen of this beautiful duck, the first which I have seen, was shot in the bay of Laprairie this spring (1862) by a *habitant*, and was purchased by Mr. Thompson of this city, who has kindly placed it at my disposal for examination, I believe it to be one of the rarest of our visitants of this species, and to demonstrate that an acquaintance with our Fauna must be a work of many years.

A. marila. Scaup duck.
Fuligula marila of Stephens and Bonaparte ! !
Fulix marila. Baird !

V.S.P. Bill greyish blue; nail black; legs and feet blackish brown; irides yellow; eggs unknown.

Dorsal aspect. Frontlet black; all the other parts of head and upper part of neck glossy dark green; remainder of neck, commencement of back, shoulders, rump, and tail coverts, black; interscapulary region and scapulars finely waved with zigzag lines of clove brown on a white ground; long scapulars glossy blackish green; wing coverts hair brown, the inner ones finely waved with white; primaries hair brown, paler on the inner webs; speculum white, bounded superiorly, inferiorly, and internally by glossy blackish green.

Ventral aspect. Chin and throat brownish black; lower half of the throat, breast, and sides of the rump, black; belly white; vent white, waved with clove brown; sides white; flank feathers waved with clove brown near the tips; tail coverts brown.

1st primary longest, the rest graduated; length 20½ inches; alar expanse 30 inches; length of bill from the frontal feathers 1 inch 10 lines. The female has the head and neck blackish brown; lower part of the neck, breast, and rump, dark brown. The young males resemble the female.

A. rufitorquis. Ring-necked duck.
Fuligula rufitorquis of Bonaparte !
Anas fuligula of Wilson !
Fulix collaris. Baird !

V.S.P. Bill black, except a line round the base, a belt near the

tip, and the rictus, which are light blue; legs and feet blackish brown; irides yellow; eggs unknown.

Dorsal aspect. Frontlet blackish brown; crown, checks, upper part of neck, and nuchal region, black, with a violet purple iridescence; collar round the neck dark chesnut; remainder of the neck, shoulders, interscapulary region, rump, and tail coverts brownish black, with a minute sprinkling of white on the scapulars; wing coverts and tail brown; primaries blackish brown, paler on the inner webs; long scapulars blackish green; speculum blueish ash, bounded superiorly and internally by blackish green.

Ventral aspect. Chin white; throat to the collar blackish brown; breast black; belly white; vent, sides, and flanks, white, waved with zigzag lines of clove brown; sides of the rump and tail coverts brownish black.

1st primary longest; length 18¼ inches; alar expanse 26 inches; length of bill from the frontal feathers 2 inches 2 lines. In the female the dorsal plumage is dark brown edged, as also on the breast, with chesnut.

Genus Mergus.

Gen. Char. Bill moderately long, slender, and straight, suddenly narrowing from a broad base, the edges serrated, and with subulate and sharp teeth inclining backwards; nostrils lateral and subcentral; tongue short and subulate, with recurved papillæ; legs short, placed far back on the abdomen, with full webs; hind toe touching the ground at its tip, and furnished with a membrane.

M. serrator. Red-breasted Merganser.
M. serrator. Baird!

V.S.P. Bill brownish on the ridge, orange at the sides, and on the lower mandible; legs and feet red; irides red; eggs 8 to 13, bluish white.

Dorsal aspect. Head and neck jet black, with dark green iridescence; occipital crest black, composed of long slender feathers; collar round the throat white, with a black mesial nuchal line; remainder of the throat chesnut brown, the feathers bordered with black; interscapulary region, short, and inner long scapulars, jet black; rump grey, waved with irregular lines of white; tail coverts cinereous, with pale edgings; tail hoary greyish brown; shoulders white, the feathers broadly edged with jet black; outer short scapulars, inner wing coverts, and outer long scapulars,

white, the latter bordered with black on the outer vanes; speculum white, crossed with black; primaries blackish brown.

Ventral aspect. Chin and upper part of the throat to the white collar, velvet black; breast chesnut brown, the feathers margined with black; belly, vent, and tail coverts, white; sides, flanks, and sides of the rump, white, elegantly waved with zigzag lines of black.

1st primary longest; length 25½ inches; alar expanse 32 inches; length of bill from the frontal feathers 2 inches 4 lines. The female differs very little from the male.

M. cucullatus. Hooded Merganser.
Lophodytes cucullatus. Baird!

V.S.P. Bill, legs and feet, blackish red; irides red; eggs 6, white.

Dorsal aspect. Frontlet, crown of the head, blackish brown; occipital crest large, white tipped with blackish green, the white coming behind the orbit, and forming a triangular space, the apex of which is the eye; sides of the neck, nuchal region, and short scapulars, black, with a deep sea green iridescence; long scapulars sea green black, with a stripe of white; rump and interscapulary region brownish black; tail coverts blackish brown, edged with brown; tail long, brownish black; shoulders with two broad bars of black and white; primaries clove brown, paler on the inner webs; small wing coverts cinereous; great wing coverts grey; speculum white, with two black bars.

Ventral aspect. Chin and throat blackish green; breast, belly, and vent, white; sides and flanks chesnut brown, waved with black; sides of rump brown; tail coverts greyish white, sprinkled with brown.

2nd primary longest; 1st longer than the 3rd; length 21½ inches; alar expanse 28 inches; length of bill from the frontal feathers 1 inch 11 lines.

M. Merganser. Gooseander.
M. castor of Gmelin, Latham, and Finch! !!
Mergus Americanus. Baird!

V.S.P. Bill black on the ridge, vermillion on the sides, and horn colour on the tip; legs vermillion colour; irides red; eggs 10 to 14, white.

Dorsal aspect. Head and upper part of the neck blackish green, with a purplish green on the cheeks and a verditer green

on the neck ; lower part of neck white ; anterior part of the back and inner short scapulars jet black ; interscapulary region, rump, and tail coverts, bluish ash, the rump feathers tipped with white ; tail hoary cinereous ; primaries blackish brown, paler on the inner webs ; secondaries white ; great and small wing coverts white, the latter tipped with black.

Ventral aspect. Chin black, with a purple iridescence ; upper part of neck blackish green ; lower part of neck, breast, belly, vent, central tail coverts, and sides, white, glossed with flesh colour ; flanks and sides of the rump cinereous, speckled and barred with white ; lateral tail coverts white, sprinkled with crimson on the outer vanes.

1st primary longest ; length 27 inches ; alar expanse 34 inches ; length of bill from the frontal feathers 2 inches 3 lines ; length of middle toe, tarsus, and nail, 5 inches 9 lines.

A bird before me in the act of moulting, presents brown feathers, appearing through the blackish green ones of the crown and sides of neck ; and white ones through the purplish black of cheeks and chin ; and the outer scapulars cinereous. Ashy feathers through the white ones of the neck ; but in all other respects resembling the perfect specimen described.

In the female the head and neck is rufous brown, with the exception of the belly and vent, which are white tinged with flesh colour ; all the other parts which are white in the male are ashy, and the dorsal aspect generally is ashy, tipped with white. The young birds precisely resemble the female.

ARTICLE XL.—*Notes on some of the habits of the pine-boring beetles of the genus Monohammus.* By E. Billings, F.G.S.

(*Read before the Natural History Society of Montreal, 24th Nov.*, 1862.)

The number of insects inflicting injuries upon forest trees by feeding upon the roots, bark, wood, or leaves, is much greater than is generally supposed. Entomologists have ascertained that nearly two hundred species prey upon the English oak alone. In Canada, where there are such vast forests of so many different kinds of trees, there must be quite a multitude of the wood-destroying tribes to occupy the attention of the naturalist. To work out the history of these, is, to us Canadians, a labor of something more than mere scientific importance ; for there are few countries

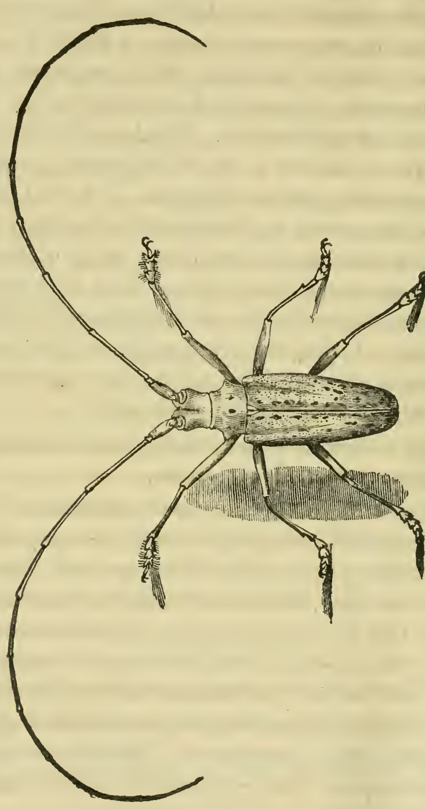
whose commercial prosperity depends so largely upon the growth of native woods. Full one fourth of the total value of our export trade is derived from the forests, and there is usually about one tenth of the whole province under license from the government to the lumberers for the purpose of making timber.* Besides this there are great tracts of land covered with wood of commercial value, in which, the sound of the lumberer's axe has never yet been heard. How long this great source of national wealth is to remain unexhausted, and what are the causes which may some day put an end to so important a branch of our commerce, are subjects well worthy of serious consideration. It belongs to Canadian Entomologists to give an answer to one of the several questions that must be discussed during the investigation. I do not profess to know enough of the science to class myself in that body of observers; but having lived many years in the valley of the Ottawa where there are extensive forests of pine, I have paid some attention to the habits of several of the most prominent of the wood-destroying beetles. I shall this evening give a short account of some of the species, although I do not feel quite sure that Ento moligists will think my remarks of much value.

It appears that in Canada we have four species of beetles belonging to the longicorn genus *Monohammus.*

The largest, and apparently the most abundant of these is *Monohammus confusor*, a magnificent insect, and very destructive to the several kinds of pine timber of this country. The length, exclusive of the antennæ, varies from three fourths of an inch to one inch and a half, the majority of the individuals being about thirteen lines. The antennæ of the males vary in length from one and a half to three inches; the female is about the same length as the male, but her antennæ are always shorter and her body broader. When very perfect, these insects are of a light ash-grey color, with a few dark brown spots. The grey colour is due to a coat of very

*By a reference to the trade returns for the year 1861, it will be seen that our total exports during that year, amounted to $36,614,195, and of this sum the products of the forest made up $9572,645, or somewhat more than one fourth of the whole. Mr. Langton, (Auditor General) says that in 1860 the quantity of land licensed by the government to lumberers, was "27,413 square miles, or 17,544,320 acres." See an interesting article by JOHN LANGTON ESQ., (Auditor General) "*On the age of timber trees and the prospects of a continuous supply of timber in Canada.*" Trans. Lit. and Hist. Soc. of Quebec, vol. 5, page 61, May 1862.

fine short light hairs. When these are rubbed off, the head and thorax are seen to be nearly black and smooth and shining, the thorax being scarcely at all punctured. The elytra, when deprived of the hairs becomes of a horn colour, darkest near the thorax, and covered with small punctures. Some specimens are almost entirely destitute of the dark brown spots. and in general the num-



Monohammus confusor, male (the first joint of all the tarsi is too short in the figure.)

ber and size of these marks vary a good deal. On each side of the thorax there is a short broad-based spine. The antennæ consist of eleven joints, the second of which is very short, and the first much thicker than any of the others. This species is found in all parts of Canada where there are pine trees, and Dr. LeConte says it is abundant at Saratoga in New York.* A specimen has lately been caught flying in the streets of Philadelphia.†

* Le Conte, Jour. Acad. Nat. Sci. Philadelphia, 2d Sec. Vol. 2, p. 148.
† Trans. Entomlogical Society of Philadelphia, Vol. 1, p. 98.

Next in order is *Monohammus scutellatus* (Say), which is about one fourth smaller than *M. confusor*, and can always be readily recognized by its dark, nearly black, shining bronze colour; some of the individuals having a few irregular spots of yellowish white scattered over the surface. The thorax and elytra are rugose, with large transverse punctures, or rather short confluent wrinkles distinctly visible to the naked eye. The scutellum is white, the thorax armed with a short spine on each side. The length of this species is usually eight or ten lines, but individuals of from five to eight lines are occasionally met with. The antennæ are from three fourths of an inch to two inches in length.

This species, although not so abundant as *M. confusor*, appears to have a more extensive geographical distribution. It occurs in all parts of Canada, and it is found also in Nova Scotia, and in the Hudson Bay territories, northward to the Arctic regions. Mr. Couper says it was taken by Sir John Richardson at Fort Simpson on the Mackenzie River, in lat. 62° N*. Mr. D'Urban says it was procured by Mr. Barnston, from Great Slave Lake, in lat. 54 N.†

The third species is *Monohammus marmoratus*, (Randall). It is described by Le Conte as being very much like *M. confusor*; the principal difference consisting in the markings of the thorax, which is closely covered with large rugose punctures, while in *M. confusor* this part is not punctured. The antennæ are black, and in the female annulated with ash-grey. The elytra are quite scabrous at the base from elevated points." Le Conte now unites with it *M. maculosus*, (Haldimand) and his own two species, *M. mutator*, and *M. fatuor*; the first of the latter two described in Agassiz's Lake Superior, and the last in the Jour. Acad. Nat. Sci. Phi. 2d Ser. Vol. 2, p. 148. It is abundant at Lake Superior. I have never seen it; and if it occurs in the valley of the Ottawa, it must be very rare.

The fourth species is *Monohammus titillator*,‡ (Fabricius), Mr. Couper cites it as occuring at Toronto, (Canadian Journal, 1st Ser. Vol. 3. p. 212.) It is also given in Mr. Ibbetson's list of Canadian Coleoptera, at page 326 of the same volume. As neither of these two entomologists mention *M. confusor*, and as the original spe-

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* Couper in Canadian Journal, 1st Ser. Vol. 3, p. 212.

† D'Urban in Canadian Naturalist Vol. 5, p. 227.

‡ In the new edition of Harriss' Insects this species is figured with thirteen joints in the antennæ.

cimen on which the species *M. titillator* was founded is an insect from the Southern States, it may be that they have applied the name to our most common and largest species. This question however, remains to be decided by further observations.

There are in the collection of McGill College three specimens from Toronto, of the size of the smaller individuals of *M. confusor*, which have a light reddish tinge different from the usual colour of that species. I have also seen several specimens from Lake Simcoe, in the collection of Capt. Rooke of the Scots Fusilier Guards, which seem to be of the same colour as those of McGill College. I have never seen this variety in the valley of the Ottawa, and it may be peculiar to the western part of the province. Whether or not it will constitute a distinct species, remains for our entomologists to determine.

The first two of these species, *M. confusor*, and *M. scutellatus*, attack and destroy great quantities of pine timber. No doubt the other two species do also prey upon the pines, but I have never yet observed them; and, in fact, they appear to be either rare or of a limited geographical distribution. The trees attacked by them are the white or Weymouth pine, (*Pinus strobus*) and the red pine, (*P. resinosa*) the two most valuable timber trees of Canada. The female *Monohammus* during the summer and autumn lays her eggs in crevices in the bark both of the standing trees, and of those which are dead and lying on the ground. The larva, after being hatched, soon acquires strength of mouth sufficient to enable it to work its way deeply into the wood. There it remains about a year, boring a long winding gallery nearly half an inch in diameter, sometimes into the very heart of the tree. As the time approaches for its final transformation, it turns, and works outwards towards the surface; just before reaching which it enters the chrysalis state. When the perfect beetle is developed, it soon, with its powerful mandibles, gnaws a passage for itself to the open air. I am of opinion that the insect does not come out as soon as the opening is made, for I have often seen them lying quite motionless in their burrows, with the head just peeping through. In this position the antennæ are not visible, as they are laid back on the sides of the body. On the 20th of July, 1860, while crossing Mount Royal, I noticed in a fallen pine tree, on the top of the mountain, several burrows in the bark, which had been lately opened, and were empty. On examining further, I found three others, with the head of a *M. confusor* filling each; on being

touched they withdrew a short distance, but not out of sight. With the point of my geological hammer I soon stripped off the bark, and extracted all three. It seems improbable (although it is possible) that they all arrived at the surface at the same time. It is more probable that after the opening is made, the insect remains for a while, perhaps for a couple of days, in its burrow, until its elytra become consolidated. Although I have often found large white or yellowish larva, deep in the body of pine trees, I have never been able to ascertain to what species they belonged. This and many other questions relating to the natural history of these insects, remain to be decided by the researches of our entomologists.

These insects attack dead timber, and also trees which have received some injury, and are in an unhealthy condition. I have never seen the female laying her eggs on a perfectly healthy and sound pine tree. Timber newly fallen is always attacked by them. The first dwellings constructed in the new settlements are generally made of logs with either the whole or a portion of the bark remaining on them. The inside is not plastered, except in the crevices between the logs; if these latter happen to be pine, the *Monohammus* lays her eggs in the bark, on the outside of the house, and for months afterwards the larva may be heard in the stillness of night, making a noise like the boring of a small augur. The perfect insect sometimes comes out on the inside of the wall, and suddenly drops down upon the floor, the table, or the bed, to the great consternation of the inmates, who imagine that an insect with such great horns must bite or sting with proportionate severity.

For the manufacture of boards or planks, the pine trees are cut up into lengths of from 12 to 18 feet, and are either drawn or floated to the mill. The logs are got out during the winter, and if they remain in the mill-yard one season, they are invariably found to be bored through in all directions by larva of these beetles, and the boards greatly deteriorated in value. Where extensive operations are carried on, a single lumberman will sometimes have a license giving him possession of over a hundred square miles of pine forest. In the months of May and June it often happens that great fires sweep through the woods, burning up all the fallen trees and dry branches strewn over the ground, and so scorching the living pines that most of them wither at the top and die during the season. Trees thus injured are soon after

attacked by both *M. confusor* and *M. scutellatus*, and within one year are so greatly bored that they are unfit for the manufacture of timber. Those experienced in the business, however, well understand the habits of the insect in this respect, and hasten to make the timber before it is destroyed. Pines scorched by the spring fires must be cut down and made into timber the next autumn. After one of these fires it generally happens there is a regular race between the lumberers and the beetles, the prize being a grove of white or red pine. I was told that Messrs. Egan & Co. lost £40,000 worth of timber by some unavoidable delay of a few months. Pine trees, when scorched, would be sound enough for timber five years afterwards, if it were not for the attacks of these formidable destroyers.

Where there are only a few pines, as in the neighborhood of this city, it is rare to meet with more than one or two of these beetles together. But in the great forests of the Ottawa it is not unusual to find 15 or 20 on a single tree. On one occasion I saw an extraordinary number, and entered an account of the circumstances in my note book on the spot. It was on the 11th day of September, 1857. I was at that time making some geological observations in the neighbourhood of Lake Clear, in the county of Renfrew. Following an old lumber road through the woods, I came to a place which had been burned over some time during the preceding spring. There was one large white pine standing on the sunny side of a small gently sloping hill. The height of this tree was about 120 feet, and its diameter nearly 3 feet. About 30 feet at the base was scorched. It was 60 feet to the lowest branch, and as nearly as I could judge, the foliage for 20 feet at the very top, had turned yellow. The remainder was green and apparently healthy. This tree was swarming with *M. confusor*, and many of the females were occupied in laying their eggs. I think there were at least 300 of both sexes, and I saw several flying from other trees 30 or 40 yards distant. In flying, the body is not horizontal, but inclined at an angle of only 15° or 20° from the perpendicular. The insects were on all parts of the tree, and they did not appear to take a firm hold of the bark, for a heavy blow with the hammer, at the base, would bring down a dozen at a time, some of them falling from near the top. While falling, they did not attempt to fly. I had 50 or 60 crawling around me at once, and had a fine opportunity to observe the very considerable variations in the size of the individuals, and length of the

antennæ. When two of them going in opposite directions, met face to face, a clumsy kind of a fight took place, in which they reared up and pushed against each other, until one or the other fell over backwards. They bit each other with their mandibles, but with no effect that I could perceive. The females fought with each other, or with the males, indifferently. There can be little doubt but that this tree was, during the next twelve months, totally destroyed. If there were 150 females, and if each laid 200 eggs, and half of these produced a healthy larva, then in one year this tree must have been perforated by 15,000 galleries. I examined other trees in the neighbourhood, and on a few only did I see any of the beetles, usually from one to four or five on each. I can only account for the preference given to this particular tree, by supposing that it was in a better condition for the nourishment of the larva than the others, and that the instinct of the females directed them to it. It is probable that nearly all the females for a considerable distance around were thus brought together on one tree, and were followed by the males.

I cannot say whether or not these insects ever attack a perfectly healthy and sound tree. I think they do not; and yet their ravages are certainly highly injurious to the commerce of this country, as they destroy a vast deal of the fallen or scorched timber, which otherwise might be brought to market at any time during several years after the trees have received their death-blow by fire or storm. I think also that thousands of the trees, only sufficiently injured by fire to throw them for a while into a weakly or unhealthy condition, would recover were it not for the attacks of these formidable creatures.

The beetles of the genus *Monohammus* are, as is well known to entomologists, assisted by many species of other genera in the work of destroying pine trees. Canadian naturalists who have selected the wonders of the insect world for their study, have before them a vast and little-wrought field. In an interesting paper on the trees of Canada, by our colleague, Mr. Robb, it is said that Canada produces " about seventy kinds of timber trees, of which, at present, we make profitable use of not more than eight or ten, the rest being left to absolute decay. Her forests extend over about 360,000 square miles; and are unrivalled throughout the world for the variety of species, and more particularly for the size of the timber of full growth. Of sixty-four samples sent to the Paris Exhibition of 1855, by Mr. Andrew

Dickson, of Kingston, one half were collected from an area of one hundred acres. The trees which we find most generally in our woods are the oak, beech, maple, iron-wood, elm, birch, ash, pine, hemlock, tamarack, cedar, poplar, and bass-wood. All these trees attain to a considerable size, and grow to a greater or less extent, in all parts of Canada, except on the coast of Labrador, where the only trees that thrive are the white birch, the fir, spruce, beech, and one of the varieties of pine. The trees of smaller growth common to all the country are the hickory, willow, alder, wild-cherry, dog-wood, sassafras, and a few others. The black-walnut, tulip-tree, and chesnut are confined exclusively to the western peninsula. Oak and elm are more abundant and of better quality in Canada West than in the eastern part of the province; but all the other woods attain greater perfection in Canada East." * Now all these trees have their own species of insect persecutors. How many species prey upon each tree? When does each species deposit its eggs, and in what part of the tree? when is the larva produced, what is its form, and upon what part of the tree does it feed? how long does it remain in the larval state? what is the form of the chrysalis,and when does the imago appear? and lastly,is there any method of protecting the tree? When all these questions shall have been answered, our entomologists, of which we have now a few good men and true, will have performed a great work. It seems almost impossible to protect a forest against an insect foe, but who knows what may be achieved by patient study? By accumulating facts, sooner or later, a means of protection may be discovered. At all events, when our interests are threatened by an enemy, it is well to know all about him, his numerical strength and the plan of his operations; without knowing these we can never hope to discover his weak points.

ARTICLE XLI.—*Zoological Classification; or Coelenterata and Protozoa, versus Radiata.*

The recent appearance of the fourth volume of Agassiz's magnificent contributions to the natural history of North America, and of various manuals, text-books, and articles, on the sub-divisions of the *Radiata* of Cuvier, have forcibly attracted our atten-

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* *Descriptive list of the principal Canadian Timber Trees.* By Charles Robb, C. E. Canadian Journal, 2nd Ser., Vol. 6, p. 29.

tion to the state of the classification of these creatures, and the changes recently proposed in it.

We are not *specially* zoologists, but have devoted some attention to the subject in its relations to geology, and as interesting in itself, as well as in connection with the teaching of its elements to students. We speak, therefore, as addressing zoological specialists from without their own circle, and desire to do so with all the humility becoming this exoteric position.

A number of zoologists have lately added to the Cuvierian fourfold division of the animal kingdom, two new types of *Protozoa* and *Coelenterata*, the former being probably more widely accepted than the latter, though it also is supported by some high names. We have not been able to convince ourselves of the necessity of either of these groups, in the rank assigned to them; and, on the contrary, fear that their establishment will tend to confuse our conceptions of the natural subdivisions of animals.

The group of *Protozoa* is confessedly distinguished from the others merely by negative characters,—by deficiency of important systems of organs, as of nervous system and organs of sense. It cannot, therefore, be regarded as embodying a type of structure distinct from those of the *Radiates*, *Mollusks*, and *Articulates*, but rather as embracing all the creatures which are so simple that we cannot recognise in them any distinct type. It is obvious that such a group, however convenient, cannot be recognised as coordinate with the others above named, and that it must be merely provisional, containing animals whose affinities have not yet been ascertained, and which may be humbler members of one or all of the other recognised types. The real question as to the position of these creatures is this.—Can we ascertain their affinities? If we can, let us place them in their true relations. If not, let us admit that they do not consitute a veritable sub-kingdom, but merely a residuum which we are unable to classify.

Regarding, with Carpenter, the *Protozoa* as consisting of *Rhizopoda*, *Porifera*, *Infusoria*, and *Gregarinida*,* it is at once apparent: (1.) That all these creatures, in point of simplicity of structure, are as low as, or lower than the humblest members of the other invertebrate kingdoms. (2.) That they do not present, in any distinct form, the types of structure characteristic of these sub-kingdoms. (3.) That many of them strongly resemble the

* These latter may possibly be humble *Entozoa*.

embryonic or immature stages of certain *Radiates*, *Mollusks*, and *Articulates*. These statements being admitted, it remains to enquire whether the balance of affinities inclines to one rather than to the others of these provinces or sub-kingdoms.

The great difficulty here is to find any distinct type of structure in these humble creatures, and some of the naturalists best acquainted with them hold that no such affinities are to be discovered, while others appear to think that their affinities would place them at the base of more than one province. In these circumstances, we are more likely to be guided aright by a consideration of the general principles of classification, than by that minute search for distinctions with which zoologists are more familiar.

To any philosophical student of animals, it must be apparent that our primary divisions or types are based on considerations of general form, and of the arrangements of the nervous system, and organs of support. On the first of these grounds alone, we must of necessity divide animals into but two groups of *Radiata* and *Bilaterata;* on the second, it is equally apparent that we must have two groups of *Vertebrata* and *Invertebrata.*

There has been of late a tendency among many naturalists to deny or overlook the fact that many of the lower animals present, in the words of Agassiz, "a vertical axis, around which the primary elements of their structure are symmetrically arranged," while the main axis of the body cannot, as in the other animals, be regarded as a horizontal one, with corresponding parts on its two sides. But nothing can be more illogical than to overlook this general radiated arrangement, because some subordinate parts present traces of bilateral symmetry. It is a mere forcing of nature within the bonds of an arbitrary system. It would be quite as reasonable to deny the prevalence of radiation from an axis or centre in plants, because a is bilateral; or to maintain that a cuttle fish has no bilateral symmetry because its arms spread from a centre; or that a man is a radiated animal, because the iris of hiseye is radiated. The *Radiata* constitute a division of animals asnatural on one ground, as the *Vertebrata* do on another.

Vertebrates, again, differ from *Invertebrates*, in the grand distinguishing point of the separation of the principal masses of the nervous system from the general viscera, in a distinct chamber above the centres of the system of support.

If we separate the *Vertebrates* on the one hand, and the *Radiates* on the other, there remain the *Mollusks* and *Articulates*, groups as markedly distinct from each other, as from the other provinces. We may thus obtain by a somewhat different process from that usually employed, the fourfold Cuvierian classification into sub-kingdoms, and this without leaving any distinct place for the *Protozoa* as a group of this rank.

Let us next inquire if the *Protozoa* may rank as a class. Agassiz has well shown that our classes, orders, &c., in zoology are not arbitrary or accidental, but based on the relations of our own minds to the actual order of nature. Classes, he maintains, are formed on the manner in which the plan or type embodied in the province is carried out, so far as ways and means are concerned; and we may add, of course, with a reference to uses or objects. It seems to have occurred to him that this implies a certain and definite number of classes to each province, for he has but three in each of his invertebrate provinces; though he subdivides more minutely in the vertebrates, deviating in this, as it appears to us, from the large general view which he has himself expressed.

In the *Vertebrates* four classes have commended themselves to the common sense of mankind,—the mammals, birds, reptiles, and fishes; and while it is easy, for example, to subdivide the reptiles into two groups, or the fishes into several, these have obviously respectively a less value than the mammals and birds, and consequently cannot be classes. What, then, are the *ways*, *means*, and *ends* involved in the vertebrate sub-classes? They are as follows: 1st. The mammal implies reproduction without metamorphosis, and the highest development of the sensorium and of intelligence. 2ndly. The bird implies the highest development of the locomotive apparatus, and parts subsidiary to this. 3rdly. The reptiles imply development of the merely vegetative life. 4thly. Fishes embody the lowest condition of the external members and respiratory process, and of the nervous system.

A little thought may satisfy us that we cannot suppose a fifth class co-ordinate with these four, however much we may subdivide any one of them. The question remains, do the other provinces admit of more divisions, or of fewer? If truly co-ordinate with the first, they should admit of the same number, because each type is placed in the same circumstances, in respect to ways, means, and ends.

In the *Articulates* we can readily distinguish four classes, corresponding to those of the *Vertebrates:* 1st. The arachnidans, with high sensorium and intelligence, and no metamorphosis, and representing the mammalia; 2nd. The insects, corresponding to the birds; 3rd. The crustaceans, corresponding to the reptiles; 4th. The worms, corresponding to the fishes.

In the *Mollusks*, we have: 1st. Cephalopods, corresponding to arachnidans and mammals; 2nd. Pteropods and gasteropods, corresponding to birds and insects; 3rd. Lamellibranchiates, corresponding to reptiles and crustaceans; and lastly, the tunicates, brachiopods, and bryozoa present an enlarged representation of the fishes.

If the *Radiates* really constitute a natural group, they should conform to this general plan. Here we have: 1st. Echinoderms, which constitute a class, and the highest of the province; 2nd. Acalephs, the specially locomotive class; 3rd. Anthozoa, or actinozoa, or polyps, the vegetative class; and lastly, protozoa, with the lowest endowments in respect to internal parts and sensorium.

Our *Protozoa* are thus required in order to bring the *Radiates* into harmony with the other provinces; and it seems plain that the group is much nearer its true place as a class, than as a province. The question still remains, whether some of the *Protozoa* might not be more naturally placed at the base of other sub-kingdoms than those of the *Radiates*, as, for instance, the *Vorticellæ* with the *Bryozoa; Gregarinida* and some *Infusoria* with the worms. It seems likely that this may eventually be done; and that just as the *Bryozoa*, *Entozoa*, and *Rotifers* are now generally separated from *Radiates*, a more nice analysis of the characters of the more aberrant *Protozoa*, may enable some of them to be separated from that group.

As an additional evidence of the correctness of the view above stated, I may remark that the divisions of *Protozoa* proposed by Carpenter have much more of the character of orders than of classes, in this respect that they imply rather gradations of rank than different ways and means of execution. Another proof is offered by the strong resemblance of many *Protozoa* to the embryonic states of true members of the province *Radiata*.

With respect to the *Coelenterata*, the case is still more clear. The structural and embryonic evidence given by Agassiz, in his last and the preceding volume, amply prove the affinity of these

creatures to *Echinoderms*, their radiated structure, and their place in the system as two of the classes of the *Radiata*.

It may be objected that these views savour of the arbitrary methods proposed by MacLeay and Swainson. If, however, there is system in nature, it must admit of some general statement; and the time must come when naturalists will be obliged, by the necessities of the case, to search for and apply such general views.

Specialists will object that they must have more subdivisions of animals than those above admitted; but they have full scope for this in the formation of families, orders, and genera, without attempting to disintegrate our higher groups. The family, in particular, as distinct from the order, is a group of great value, and to the cultivation of which their attention might be very properly directed, more especially since the genus is fast losing its importance, from the tendency to erect every little group of species, distinguished by some minute structural peculiarity, into a new genus. Since, however, the greater part of these are clearly nothing but sub-genera, it might be well to have some arrangement which might enable them to be recognized for purposes of determination, while the grand generic unity should be maintained by retaining the name of the genus proper, in the nomenclature, with a mark or number to indicate the sub-genus.

The views thus slightly outlined are not of yesterday; but have resulted from much thought on the subject. They are, however, thrown out merely as suggestions for the consideration and criticism of naturalists, and in the hope that they may, at least in part, be found to harmonize with the true order of animal nature in its lower forms, as the progress of discovery brings this more distinctly into view.

J. W. D.

ARTICLE XLII.—*On a new Crustacean from the Potsdam sandstone.* By Prof. JAMES HALL. *A Letter addressed to Principal Dawson, dated Albany*, 31*st October*, 1862.

I have been much interested in reading your observations upon the tracks of *Limulus* in sand, and comparisons with the tracks in the Potsdam sandstone;* more especially as these observations connect themselves in a remarkable manner with a recent discovery of my own; and a question may arise as to whether you have

* Canadian Naturalist for August, 1862.

described an animal which I have found, or I have found the animal corresponding to your description. I will leave you and the scientific world to judge of the facts. However, after what you have written, I cannot now publish what I communicated to the Albany Institute last winter, without referring to your paper, and in the mean time you may lay this note before the Montreal Natural History Society, and publish it, or such parts of it, as you please.

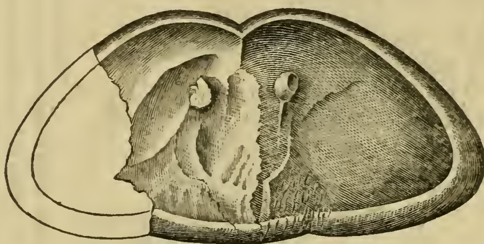
In February last, I communicated to the Albany Institute a notice of a new crustacean from the Potsdam sandstone of Wisconsin, and subsequently I sent a drawing of the same to M. Barrande. In 1855, I obtained from the Potsdam sandstone of the upper Mississippi River, a fragment of what appeared to be a spine of a crustacean, of very remarkable and peculiar structure, reminding one of that of bone; and which might at one time, before we had accustomed ourselves to limit the geological range of fishes, have been taken for an ichthyic remain.

This fragment remained in my collection a subject of much interest, for I was aware from its structure that it could belong to no genus of Trilobites, but at the same time I did not think it worth while to publish any notice of it from its incompleteness.

In 1857, Mr. Daniels, of the Geological Survey of Wisconsin, discovered in the Potsdam sandstone of Black River, in that State, tracks similar to those described by Sir W. E. Logan, in the sandstone of Canada. This added a new interest to the unknown crustacean fragment; and in 1860 I visited the Black River region, to procure if possible some of these impressions. I failed however in finding the precise locality; and in 1862 sent my assistant in the Wisconsin survey, Mr. Hale, to make farther explorations, but he did not succeed in finding anything of interest. At another locality however, he obtained some fragments of the crustacean before mentioned, among which are two cephalic shields sufficiently perfect to be characterized. I inclose you a drawing of one of these.

The relations to *Limulus* are at once suggested by the form and expression of these carapaces, while the large prominent eye-tubercles hold relatively the same position as the small approximate oculiform tubercles or spots on the anterior part of the shield in *Limulus*, (and also in *Eurypterus*). The carapace is proportionally flatter than in *Limulus*; and has, like that, a strong

thickened border; the posterior angles rounded. The margin is impressed or sinuate in front, and there are slight indications of longitudinal grooves on each side of the central, leaving a median lobe proportionally wider than in *Limulus.* The eyes, though imperfect, remind one somewhat of the eyes of Trilobites, and are remarkably prominent.



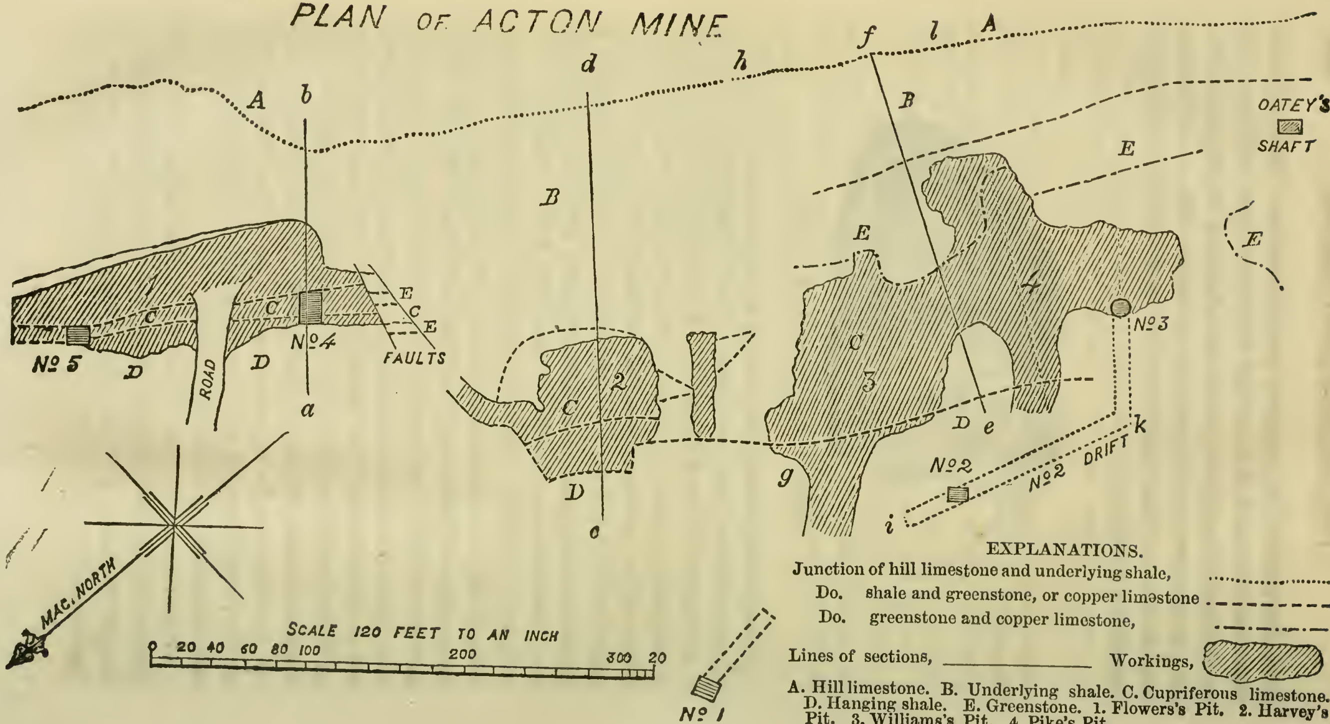
Carapace of *Aglaspis* from Wisconsin.

There is a single fragment of what appears to have been an articulation of the thorax, or a portion of some appendage analogous to the branchial feet of *Limulus*; it has a flattened, curving, pointed extremity. Another fragment I infer may have been the caudal extremity; it is comparatively thick and strong; but the specimen is too imperfect to be determined. The first specimen I obtained is a straight spine-like body, and I infer that the animal may have been provided with a caudal spine, as in *Limulus.*

Such, in general, are the characters of this crustacean. Whether this may have been the animal which made the peculiar tracks in the sandstone, I cannot say, but I have so inferred. The first specimen was found at a distance of thirty miles or more in a northwesterly direction from the locality of the tracks of Black River, and in higher beds of the sandstone. The last found specimens are from a more distant locality, in a southeasterly direction, and also from beds above those of the tracks. All this, however, cannot furnish matter for argument against the origin of the tracks, in the present state of our knowledge of a country which has been comparatively but little explored.

Whatever may be proved hereafter in this respect, it does not diminish the great interest attaching to so new and remarkable a form of crustacean from the unequivocal primordial zone of the northwest.

PLAN OF ACTON MINE



EXPLANATIONS.

Junction of hill limestone and underlying shale, ...

Do. shale and greenstone, or copper limestone - - - - - -

Do. greenstone and copper limestone, —·—·—·—

Lines of sections, ______________ Workings,

A. Hill limestone. B. Underlying shale. C. Cupriferous limestone. D. Hanging shale. E. Greenstone. 1. Flowers's Pit. 2. Harvey's Pit. 3. Williams's Pit. 4. Pike's Pit.

ARTICLE XLIII.—*Contributions to the History of the Acton Copper Mine.* By THOMAS MACFARLANE.

(Read before the Natural History Society of Montreal.)

Three years have elapsed since the opening of the Acton Copper Mine, and probably few mines have in such a short time gained a greater or more merited celebrity. It has been my good fortune to be connected with it since September, 1861, in such a capacity as enabled me to gain much experience as to the nature and value of the deposits of copper ore, which are here the objects of mining enterprise. Had it not been for this circumstance I should not have ventured upon another description of the Acton Mine, seeing that so many valuable papers on the subject are already in our possession. As it is, the few observations which I have made, and which I now proceed to record, are only to be regarded as supplementary to former descriptions, especially to those of Sir W. E. Logan, and the Rev. A. F. Kemp ; and as embracing a sketch of the progress of the mine from September, 1861, when Messrs. Davies and Dunkin, the proprietors, received the mine back from the lessees who had previously worked it, until the first of October, 1862, when the mine was purchased by the Southeastern Mining Company of Canada.

In the month of September, 1861, mining operations were being carried on in the following workings : Flowers's pit, Williams's pit, Harvey's pit, and No. 2 shaft. It is to be observed with regard to these names, that the word pit is applied to an open working of irregular and very considerable dimensions, while the name of shaft is given only to regular sinkings of the usual and smaller dimensions. The position of the above named workings, and the character of the rocks in which they occur, and by which they are bounded, will be seen from the accompanying map.

The whole of the open workings occur upon a bed of what has been called in former descriptions "copper limestone," the general strike of which is N.E. and S. W., with a dip more or less inclined to the N. W. Immediately underlying this cupriferous limestone, which is dolomitic, there occur from twenty to eighty feet of dark colored shales, in which, especially near the cupriferous limestone, copper pyrites is frequently found disseminated in thin strings and layers. Beneath this occurs another bed of limestone, of very considerable thickness, the outcrop of which forms the hill running along the south-east side of the mine. Between the cupriferous limestone and the underlying shale, there is often intruded

a fine-grained greenstone, which sometimes forms very considerable and irregular masses, sometimes intersects the limestone strata, and often presents a peculiar banded structure, resembling more that produced by igneous flow, than that due to deposition from water. This greenstone, although intruded most frequently between the underlying shale and the cupriferous limestone, is sometimes observed occurring between the latter and the hanging shale. This hanging shale, of a black color, which overlies the cupriferous limestone, is also often impregnated with copper pyrites, and has a very considerable thickness. It has not yet been ascertained what rock overlies the hanging shale in the immediate neighborhood of the mine, but from observations elsewhere, it appears to be followed by lighter colored shales, containing small interstratified quartz veins. Upon these shales is superposed a finely and evenly foliated clay-slate, with transversal cleavage. At greater distances from the mine there is found a considerable development of clay-slates and sandstones; some of the latter possessing the characters of the greywacke sandstone of German geologists. The whole of these rocks are apparently destitute of organic remains. According to Sir William E. Logan, they constitute a part of the Quebec group, of the Lower Silurian series Referred to the systems of continental geologists, they would appear to occupy a place between the primitive slate formation and the Silurian, in a formation corresponding to Barrande's Azoic formation in Bohemia, or to the Cambrian system, as this is understood to be constituted by Cotta; viz., of less crystalline clay-slates and silicious slate, of non-fossiliferous greywacke sandstone and conglomerate.*

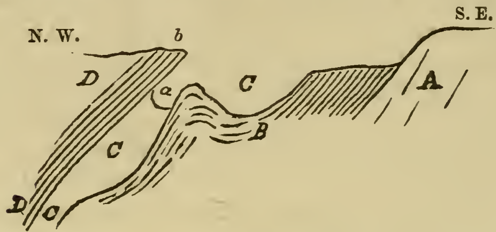
Having thus referred to the geological character and age of the rocks in the neighborhood of the mine, I proceed to describe the various workings above named. Flowers's pit, the most north-easterly of the open workings, has a triangular shape, an average width of forty-five feet, and had in September, 1861, a depth of twenty feet. The bottom of the excavation consisted, on the south-easterly side, of shale, while the outcrop of the cupriferous limestone, having a thickness of four feet, ran along the north-west side. The original thickness of forty-five feet of limestone, had thus, on account of a fold in the underlying shale, decreased to four feet, as shown in the following section at No. 4 shaft.

The excavation of the limestone at *a* was continued, (the point

*Cotta: Die Flötz Formationen, p. 204.

of shale *b* having been previously taken down) in the south-westerly half of the opening, along a distance of about sixty feet and to an additional depth of seven feet.* The limestone was more, or less charged with ore along the whole of this distance; but having in view the disadvantages which attend such large excavations in depth, it was resolved to sink a shaft, in order to examine the

Section along the line a—b of the general plan.



A, Hill limestone; B, underlying shale; C, cupriferous limestone; D, hanging shale.

ground before hand. Accordingly shaft No. 4 was commenced in the south-west end of the working, and sunk, at intervals, to a depth of seventy-five feet on the inclination of the bed. The first twenty-five feet sunk below the open working was in rock containing very good ore, of which rock eighteen and a half cubic fathoms were excavated, and yielded—

$1\frac{2}{2}\frac{0}{3}\frac{1}{5}\frac{1}{2}$ tons of first quality ore of 24.0 per cent of copper.
$133\frac{2}{2}\frac{1}{4}$ " crush " 2.0 " "

These quantities correspond, after deducting the loss in dressing the crush ore (one-third of the copper contents), to 18.6 tons of 12 per cent ore, or about one ton per cubic fathom. The cost of sinking these twenty-five feet, and bringing the rock to the surface, amounted to $482.94; or to $26.10 per cubic fathom of rock, and $25.96 per ton of 12 per cent ore. Below the twenty-five feet the ground was poor; and in June, 1862, the sinking was discontinued, in order to the stoping of the ore ground on each side of the shaft. Up to the end of July, 45.62 cubic fathoms

* It is to be remarked with regard to this and other sections in this paper, that unless when otherwise mentioned, they are not drawn to a scale, and are merely intended to give an idea of the succession of the various rocks, without reference to their thickness.

were stoped out in the north-east side of the shaft, and yielded—

$10\frac{268}{2352}$	tons	first quality	ore of	22.0	per cent.
$43\frac{1487}{2352}$	"	"	"	18.4	"
$1\frac{265}{2352}$	"	second	"	9.0	"
154	"	crush	"	4.06	"

These quantities, after deducting loss in dressing, correspond to $119\frac{850}{2352}$ tons of 12 per cent ore, or 2.62 tons per cubic fathom. The total expenses of excavation and bringing to surface, amounted to $574.10; equal to $12.59 per cubic fathom, and to $4.80 per ton of 12 per cent ore. The average thickness of the bed was here $19\frac{1}{2}$ feet, = $3\frac{1}{4}$ fathoms. Consequently one square fathom of the bed yielded 8.51 tons of 12 per cent ore, at an expense of $40.92. During the following months of August and September the stoping was continued, accompanied by drifting under the old road leading into Flowers's pit (see map). Here were excavated 63.37 cubic fathoms of ground, which yielded—

49147	lbs.	first quality	ore of	21.2	per cent.
23850	"	"	"	19.8	"
7114	"	second	"	13.5	"
17600	"	"	"	11.5	"
40320	"	crush	"	5.2	"
134400	"	"	"	4.1	"
22400	"	smalls	"	3.5	"
128427	"	"	"	2.6	"

These quantities, after deducting one-fourth of the copper contents of the crush ore, correspond to $95\frac{922}{2357}$ tons of 12 per cent ore, or 1.5 tons per cubic fathom. The total expense of mining and raising this quantity was $873; equal to $13.77 per cubic fathom, or to $9.19 per ton of ore. The average thickness of the bed was at this place $2\frac{1}{2}$ fathoms. Consequently a square fathom of the bed yielded 3.75 tons of 12 per cent ore, at an expense of $34.32.

As regards the north-east extremity of Flowers's pit, a shaft had been sunk in the limestone there previous to September, 1861, to a depth of twenty feet on the incline, below the bottom of the open working, and forty-four feet below the floor, on the present collar of the shaft, now called No. 5. At the bottom, a considerable quantity of copper pyrites was observable, partly in veins permeating the limestone, and partly impregnating the same. In order to the examination of the ground here it was resolved

to sink this shaft. The ground gradually improved, and at a depth of fifty-four feet presented an appearance exactly similar to the rich deposits previously excavated on the surface. This appearance has been most suitably and accurately described by Sir W. E. Logan as " a breccia or conglomerate, with a paste com-" posed of variegated and vitreous sulphurets of copper, mingled " with fine grained silicious matter, enclosing fragments of lime-" stone, some angular and some rounded, some of them almost " wholly calcareous and others largely silicious."* The average thickness of the bed in the ten feet thus sunk, was nine feet, the length of the shaft on the strike of the limestone, twelve feet. From the five cubic fathoms thus excavated, there were produced

$1\frac{698}{2352}$	tons first quality	ore of	22.0	per cent.
$83\frac{5}{24}$	" crush	"	4.5	"

These quantities, after allowing for the loss, correspond to 23.1 tons of 12 per cent ore, or 4.6 tons to the cubic fathom. The costs of mining the above five cubic fathoms, and bringing them to the surface, amounted to $133.33, which is equal to $26.66 per cubic fathom, and to $6.03 per ton of 12 per cent ore. Calculated at the above mentioned thickness of $1\frac{1}{2}$ fathoms, a square fathom of the bed yielded 6.9 tons of 12 per cent ore, and cost $40. The sinking of No. 5 shaft was discontinued during the winter, but resumed during the summer, and at the end of July attained a depth of seventy-six feet on the incline. From it, at a depth of sixty feet, a gallery was carried towards the west, $30\frac{3}{4}$ feet; at which distance from the shaft the limestone was cut off by the hanging wall, every indication seeming to point out the presence here of a left-hand throw. This fault had a direction of N. 10° W. Some stoping was done both above and below this gallery. Up to the end of July there were excavated in shaft, drift and stopes, $65\frac{1}{4}$ cubic fathoms of ground. These yielded

$53\frac{931}{2352}$	tons first quality	ore of	19.1	per cent.
$4\frac{2157}{2352}$	" second "	"	9.0	"
$316\frac{466}{2240}$	" crush	"	3.95	"

which quantities correspond to $155\frac{913}{2352}$ tons of 12 per cent. ore, or 2.38 tons per cubic fathom. The total expense of mining and raising this quantity was $1512.04; or $23.17 per cubic

* Report of Progress for 1858, p. 59.

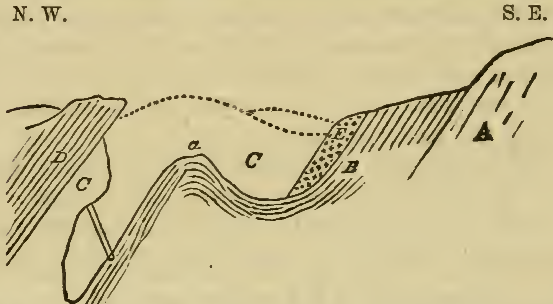
fathom, and \$9.72 per ton of ore. The thickness of the bed at this point was $16\frac{1}{4}$ feet, $= 2\frac{3}{4}$ fathoms. Consequently a square fathom of the bed contained 6.54 tons of 12 per cent ore, and cost \$26.73. The limestone in No. 5 shaft generally maintained a dip of from 70° to 80°, and the character of the ore was principally that described by Sir W. E. Logan, as above quoted. The richest specimen assayed from this shaft contained 41.2 per cent copper, and 19.2 per cent of silicious matter. It was not altogether free from limestone. The strike of the bed of limestone from shaft No. 4. to No. 5. is N. 34°. E. Friction grooves have been observed at the junction of both the foot and the hanging shale with the limestone. These generally dip to the west at an angle of about 50°. In August and September, No. 5 shaft was further sunk fifeeen feet, thus reaching a depth of ninety-one feet. The ground between the shaft and the fault above noticed was also stoped out. It was poorer than that previously excavated, but the thickness of the bed increased to twenty-four feet.

Immediately to the west of Flowers's pit, there appears to exist one or more powerful faults, which have thrown the cupriferous limestone 140 feet to the right hand. These are indicated on the map, from which it will be seen that the principal one has a direction of about east and west, and comes in at the east end of Harvey's pit, where the evidences of the existence of this right hand throw are very striking. It is worthy of remark, that a great accumulation of rich ore was excavated from Flowers's pit, at the point where this fault intersected the one described as occurring in the drift to the west of No. 5 ; traces of this are also be found on the surface. These faults, the existence of which was, I believe, first pointed out by Principal Dawson, will doubtless be found to influence considerably the ore-bearing qualities of the limestone bed.

Harvey's pit is the next open working to the west of Flowers's pit. On the surface it has a length of one hundred, and a breath of eighty feet. A section of the working, at right angles to the direction of the strike, is given on the next page ; from which it will be seen that the same relations exist here as in Flowers's pit, so far as the architecture of the limestone and the underlying shale is concerned. The same contraction in the thickness of the limestone is

visible here, as at Flowers's pit. This rock, before its excavation, bent over the point *a*, and constituted the arch of limestone mentioned in a former description of the mine, by the Rev. A. F. Kemp.* It was on this arch that the first excavation was made in opening the mine. Harvey's pit was last worked in September, 1861. The previous mining had been done very irregularly, and the cupriferous limestone had not been wholly removed; but a considerable part of it was left against the hanging wall, as shewn in the following sketch. This limestone had, moreover, been sup-

Section along the line c—d of the general plan.



A, hill limestone; B, underlying shale; C, cupriferous limestone; D, hanging shale; E, greenstone.

ported by heavy timbering, which again had been loaded with waste rock. To have taken down the whole of this limestone would have been expensive, and to have cut through it to the hanging wall beneath the timbering would have left the pit in a very unsafe condition. To have sunk a shaft at one end of the pit would probably have been the best plan, had it not been thought preferable to sink or drive from No. 1 shaft, 140 feet northwest of Harvey's pit. These considerations prevented any excavation from being made in this opening; and, since September, 1861, it has been used as a reservoir for water employed in dressing the ore. There is still ore visible in Harvey's pit, nearly in the middle at the deepest point, and on the stope at the west end.

The next open working of importance, to the west of Harvey's pit, is Williams's pit. In September, 1861, it was separated from Pike's pit by a piece of ground, since removed, under which a very large drift had been excavated. The east side of Williams's

* See Canadian Naturalist, Vol. V. page 360.

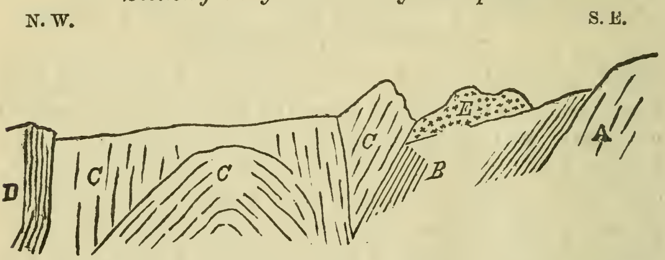
pit, was worked in September, 1861, and $161\frac{1}{2}$ cubic fathoms of rock excavated. These yielded:

$16\frac{13}{2532}$	tons,	first quality ore of	24.0	per cent.
$211\frac{17}{24}$	"	crush "	4.5	"

which, after deducting loss in dressing, correspond to 85 tons of 12 per cent ore. The eastern stope, consequently, contained 0.52 tons of 12 per cent ore per cubic fathom. The total expense of excavation was \$1292.00; or \$8 per cubic fathom, and \$15.17 per ton of 12 per cent.

The distance from the underlying to the hanging wall, on the east slope of Williams's pit, is 135 feet; which extraordinary width is wholly filled up by limestone of slightly different varieties. Next to the foot wall may be observed a fine grained, light grey limestone, with which thin leaves of slate are intercalated, the slate being the more cupriferous. Further to the north-west, there follows a limestone of a coarser grain and slightly darker color, in which the richest copper deposits seem to occur. Portions of this are also slaty, but less regularly so than the variety just mentioned. Still further to the northwest, the first mentioned

Section from g to h on the general plan.



A, hill limestone; B, underlying shale; C, cupriferous limestone; D, hanging shale; E, greenstone.

slaty limestone again appears; after which succeeds a cupriferous limestone, characterised by being impregnated with copper pyrites, and by containing here and there patches, consisting of silicious matter and copper pyrites, which project from the surface of the limestone, wherever it has been exposed to the influence of the atmosphere, in the form of moss-like efflorescenses. The extraordinary thickness which the limestone attains in Williams's pit, seems to be attributable to foldings in its strata. The stratification of the limestone is very obscure, and is rendered more so by innum-

erable joints, and veins of calcspar, which ramify through the limestone in all directions. Judging however from the position which a certain narrow band of schistose limestone occupies, it appears as if the limestone of the east slope of Williams's pit was stratified as sketched in the preceding section.

Between Williams's pit and Pike's pit there existed, as already mentioned, previous to January, 1862, an arch of limestone; which was perhaps the most picturesque feature of the mine. During the winter, a large quantity of water having accumulated in Williams's pit, and become frozen over, it was judged advantageous to take down the arch, while the access to it by means of the ice was convenient. The piece of ground on the south side of the arch abutting against a huge mass of greenstone, together with the rock above the arch, contained 770 cubic yards = 96 cubic fathoms nearly. These produced:

$4\frac{1419}{2352}$	tons	first quality ore	of	23.0	per cent.
$67\frac{9}{24}$	"	crush	"	4.7	"
$154\frac{5}{24}$	"	"	"	2.7	"

which quantities correspond to $69\frac{1}{2}$ tons of 12 per cent ore. Consequently, a cubic fathom of this rock gave 0.72 tons of 12 per cent ore. The cost of mining and hauling was \$539, or \$5.61 per cubic fathom, and \$7.75 per ton of 12 per cent ore. The following is a section of the limestone and the adjoining rocks, at this point, as seen from the north-east side, previous to the excavation:

Section along the line e—f of the general plan.

The letters denote the same rocks as in former sketches. The dotted lines show the piece of ground mentioned above. It will be observed that here also there exist evidences of foldings in the

limestone strata, and that towards the west end of the mine, the greenstone becomes extensively developed.

After blasting down the arch, Williams's pit was not worked until May, 1862. By that time, however, it was completely filled with water; and the quantity contained in it could not, considering the immense area of the excavation, have been much under a million of gallons. Previous to working the pit, it was emptied to within a few feet of the bottom, by means of a syphon made of a two-inch malleable iron pipe, 350 feet in length, leading into No. 1 shaft; from which the water was raised by the pump attached to the stationary engine there. Blasting was then commenced, and up to the end of July there were excavated 1104 cubic yards = 138 cubic fathoms of limestone, which yielded:

$6 \frac{2066}{2352}$	tons	first	quality	ore of	20.0	per cent.
$56 \frac{2338}{2352}$	"	"	"	"	18.4	"
$277 \frac{461}{2240}$	"	crush		"	5.2	"

These quantities correspond to $175 \frac{134}{2352}$ tons of 12 per cent. ore or 1.27 tons per cubic fathom. The total expense of emptying the pit, excavating the rock, and bringing it to the surface, amounted to $1092.29, or $7.91 per cubic fathom, and to $6.24 per ton of 12 per cent ore. Mining was continued in Williams's pit during the months of August and September, and a considerable part of what constituted the floor of Pike's pit was removed. During these two months there were excavated in all 1468 cubic yards = $183\frac{1}{2}$ cubic fathoms of rock; of which about one-third was in the rich ore-ground on the south-east side of Pike's pit, and the other two-thirds in the much poorer rock situated between the old face of the western stope of Williams's pit and No. 3 shaft. The following lots of ore were produced from the above quantity of rock:

236215	lbs.	first	quality	ore of	19.3	per cent.
169200	"	"	"	"	19.8	"
28456	"	second	"	"	13.5	"
120000	"	"	"	"	11.5	"
454720	"	crush		"	5.0	"
680960	"	"		"	3.5	"
143360	"	smalls		"	2.8	"
327040	"	"		"	3.5	"

These, after deducting one-fourth of the copper contents of the crush ore, are equal to $507 \frac{1329}{2352}$ tons of 12 per cent ore. Con-

sequently, a cubic fathom of this rock yielded 2.76 tons of 12 per cent ore. The total expense of mining and hauling to surface was $1777.12, or $9.68 per cubic fathom, and $3.50 per ton of 12 per cent ore. The width of the limestone horizontally across Williams's pit, at this point, is 150 feet; the width of the stope nine fathoms. If we assume the thickness of the limestone, at right angles to the underlying shale, to be twelve fathoms, which is evidently a moderate estimate, then a square fathom, along the plane of the bed at this point, contains 33.12 tons of 12 per cent ore. In the upper part of Williams's pit, the conglomerate character of the cupriferous limestone, referred to in describing No. 5 shaft, is beautifully developed. Masses of this character have frequently been blasted out, measuring at least eight cubic yards. A large mass of nearly the same dimensions was found loose on the surface of this deposit. On drilling a hole into it, preparatory to blasting it, the borings obtained were carefully collected and examined. They contained:

Silica, ...	36.98	
Carbonate of lime, ...	4.64	
Alumina, ...	0.84	
Iron, ...	7.01	
Copper, ...	34.20	by assay.
Sulphur, ...	16.33	by difference.
	100.00	

The three last ingredients calculated to 100 parts give

Iron, ...	12.18
Copper, ...	59.44
Sulphur, ...	28.38
	100.00

which figures approximate pretty closely to some analyses of purple copper. In the bottom of Williams's pit, about forty feet below where this mass was found, the ore is more solid, not so much diffused through the limestone, but concentrated in veins, which are pretty distinctly separated from the side rock. In one of these, of considerable thickness, I found the purest purple copper which I have yet observed on the mine. It contained neither lime nor silica, and assayed 61.9 per cent of copper. At no great

distance from this vein, the limestone was destitute of copper, and had the following composition:

Silica,...........................	1.50
Alumina and peroxide of iron,......	2.85
Carbonate of lime,.................	71.10
Carbonate of magnesia,.............	24.12
	99.57

Previous to September, 1861, No. 2 shaft had been sunk through shale, and into the limestone to a depth of seventy-eight feet; and a drift carried from it, at this depth, both towards the hanging wall, and towards the foot wall. The direction of this drift was N. 10° E.; consequently not at all at right angles to the direction of the strike, (which in this part of the mine appears to be N. 20° E.); but rather parallel with it. The length of the drift from the shaft to the hanging wall was forty-two feet, to the foot wall sixty feet. This latter, which was partially cut through, was found to be of greenstone, or rather a shaly greenstone, composed of alternate layers of that rock, and of shale with copper pyrites. This constituted at least the lower part of the face of the drift. The upper part was of limestone. In view of these circumstances, and although a gallery had been driven twenty-seven feet along this foot wall to the west, it was deemed proper to continue the main drift. This was done for a distance of sixty feet in the same direction of N. 10° E., always in limestone; the bottom of the drift consisting almost the whole distance of the same shaly greenstone. Some good patches of purple copper were met with, and also some veins of calcspar with purple copper and copper pyrites, dropping down from above; these veins led to the belief that the drift was being carried along underneath the ore. At the distance of 120 feet from the shaft, the direction of the drift was altered to N. 63° W. (in order to meet No. 3 shaft); the drift was then carried sixty-three feet further, always on the foot wall, which gradually rose, until the driving was discontinued; when it was found to have an inclination to the N. W. of 40°. In driving this sixty-three feet, some little copper was discovered, principally in veins of calcspar from one to three inches thick. Shortly after the driving here was discontinued, No. 3 shaft, which was meanwhile being sunk, was carried down to the drift, and made to communicate with it. No. 3 shaft had, previous to September, 1861, a depth under the floor of Pike's pit, of twenty-

six and a half feet. In March and April it was further sunk twenty-seven and a half feet, and at the depth of fifty-four feet it broke through into No. 2 drift. The last six feet sunk was in poor rock, but, previous to this, twelve feet had been sunk through cupriferous limestone, permeated by veins of calcspar and quartz, containing purple copper. One of these veins seemed, in the southeast corner of the shaft, to have a dip of about 45° to the N. W., but on the opposite side it became very much flatter

This circumstance seemed to confirm the opinion that No. 2. drift had been carried along underneath the copper, so that it was determined to stope back from No. 3 shaft, overhead in the drift. In a short time the few feet of poor rock constituting the roof of the drift were removed, and a bed of limestone exposed, containing numerous veins consisting of purple copper and silicious matter, and presenting an appearance similar to that described as occurring in the bottom of Williams's pit. The following sketch is a section along a line running from No. 2 shaft to No. 3, and thence across Williams's pit:

Section from i to k, and thence to l, on the general plan.

A, hill limestone; B, underlying shale; C, cupriferous limestone; D, hanging shale; E, greenstone; C2, dark coloured silicious limestone, distinctly stratified, with impregnating copper pyrites.

It will be observed that a jog or bend of the footwall occurs in No. 2 drift, similar to those occurring at the surface in Harvey's pit and Flowers's pit; and that it was in the basin thus formed, and a little from the bottom of the same, that the rich ore at *a* was discovered. The excavation of ore at this point, by widening the drift and stoping overhead, commenced on the 1st of June. From that date until the 8th of August, 573 cubic yards = 71.6 cubic fathoms were excavated. These produced:

$7\frac{1301}{2352}$	tons first	quality	ore of	22.0	per cent.
$13\frac{107}{2352}$	" "	"	"	18.4	"
$4\frac{1032}{2352}$	" "	"	"	24.0	"
$2\frac{505}{2352}$	" second	"	"	9.0	"
269	" crush		"	4.2	"

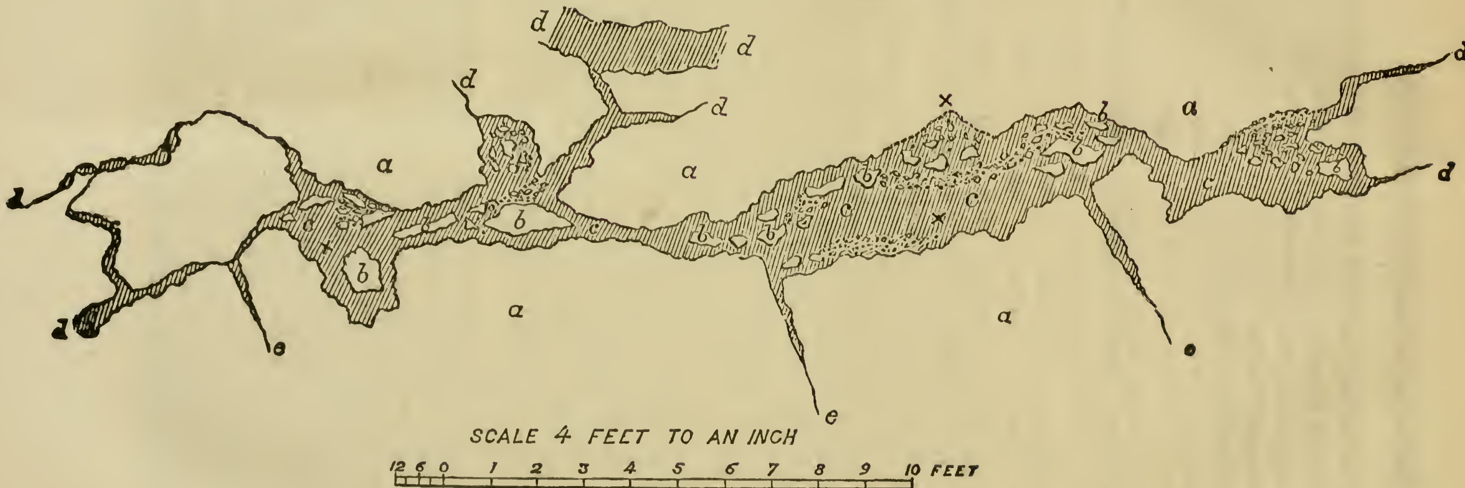
corresponding to $101\frac{808}{2352}$ tons of 12 per cent ore, or 1.41 tons per cubic fathom.

The total expense of mining and bringing to surface was $1288, or $18 per cubic fathom, and $12.71 per ton of 12 per cent ore. Mining was continued here after the above date, but up to the end of September no further measurement had taken place. Probably nowhere else on the mine are such beautiful and distinct specimens of the copper conglomerate, or rather breccia, observable, as in the excavation above No. 2 drift. In many cases the line of division between the cupreous matrix and calcareous fragments is sharp and distinct; and it not unfrequently happens that there may be found in close proximity to each other, pieces of matrix almost free from lime, and fragments of limestone containing not a trace of copper. To judge from the appearances in No. 2 drift, the cupriferous limestone there does not contain a definite bed of conglomerate running irregularly through, and subordinate to it. It seems rather that the limestone has been cracked in all directions, and is now filled with a network of veins from an inch to two and a half feet thick, and containing purple copper, copper pyrites, silicious matter, and fragments of limestone. The matter of these veins has so often a brecciated character, from the presence of angular fragments of the adjoining limestone, as frequently to entitle it to the old German name of "Gang brockengestein," a term sometimes used for characterising this brecciated structure in veins. The accompanying sketch shews a section of one of these veins cut through in stoping upwards from No. 2 drift.

The following analysis was made of a piece of veinstone, from the same vein which enclosed a well defined angular fragment of limestone:

Silica	38.65	
Carbonate of lime,	0.95	
Iron	7.31	
Copper	37.20	
Sulphur,	15.89	by difference.
	100.00	

SECTION ACROSS A VEIN IN DRIFT No. 2.



EXPLANATIONS.

a. Limestone.	e. Offshoots similar to those cut in the drift before the discovery of the copper.
b. Fragments of limestone	× Points at which specimens were taken for examination.
c. Purple copper and silicious matter.	
d. Leaders connecting with other veins.	

The angular fragment contained no copper, but gave:

Silicious matter,..............	8.25
Alumina and peroxide of iron...	2.75
Carbonate of lime.............	73.20
Carbonate of magnesia.........	15.50
	99.7

Other specimens of veinstone examined, contained as follows:—

	1.	2.	3.
Silica	18.3	30.5	36.9
Copper	47.4	42.6	33.4

From the various analyses made of the purple copper, it does not seem to differ essentially from the variety of this mineral to which the formula $Fe\ Cu^5\ S^4$ has been given.

I have thus described the progress of the mine, and the results obtained in the various productive workings during the thirteen months ending 30th September, 1862. If we take the average of these results, we find that the average produce per cubic fathom has been 1.6 tons of 12 per cent ore; the average cost of mining and bringing to surface, $11.28 per cubic fathom, and $7.03 per ton of 12 per cent ore. These, it will be observed, are the results of mining in the productive part of the cupriferous bed, exclusive altogether of the cost of explorative work, of which latter it was only in No. 2 drift that any considerable amount was done. Probably the cost of prospective work did not exceed $1.50 on each ton of ore produced; so that we may assume that the cost of searching for ore, mining and bringing it to the surface, was $8.50 per ton of 12 per cent.

Before leaving this part of the subject, I may be permitted to make some remarks as to the nature of the deposit and the source of the ore. It will probably be admitted on all hands, that the bed of limestone in which the ore occurs, is of sedimentary origin, and originally possessed a horizontal position. Nor will it probably be denied, that a part at least of the copper; viz., that part which occurs in the form of copper pyrites, finely disseminated through some parts of the rock, was deposited, in some state or other, simultaneously with the limestone. That the limestone and the rocks adjoining it have, by certain powerful agencies, been raised from their horizontal position, and in this process been

rent, broken, bent and twisted in the most violent manner, is evident from the various phenomena presented in every part of the mine. Whether this upheaval was caused by the greenstones being thrown up from beneath, seems to be uncertain, but it is probably not unreasonable to suppose that this protrusion of the greenstone occurred simultaneously with the upheaval of the strata; and that both may have been caused by certain more general and wide spread movements of the earth's crust. Whatever may have caused the upheaval, it seems sufficiently evident that the upheaval caused the rending of the limestone, the formation of the fissures and crevices, in which the copper ore was subsequently deposited, and the partial filling up of these by detached fragments of limestone of all possible dimensions. With regard to the filling up of the fissures by the copper ores, we may conceive three different modes in which this may have been effected: 1. The ores may have been injected into these fissures in a fused state. 2. They may have been removed from the impregnated side rock by certain solvents, and re-deposited in the fissures. 3. They may have been brought up from beneath by springs. With regard to the first of these theories, it must be remarked that the general appearance of the veins, coupled with the presence of greenstone in the neighborhood, would seem to be in its favor. But when it is considered that the ore is intimately associated with quartz, or rather with chert, this view of the origin of the ore does not appear admissible. It is difficult to conceive of a fused material so homogeneous as the substance which forms the matrix of the breccia, consisting exclusively of metallic sulphurets and silica. And even although it were possible to imagine a fused mass of this composition, the degree of heat required for its fusion would have been such as to exert an action on the adjoining limestone, similar to that produced by certain igneous rocks, viz., a conversion of the greyish colored limestone into white crystalline marble. With regard to the second theory, the presence of sillica does not present any difficulty, because it is a well-known fact that that substance is deposited in large quantities from hot springs. It is not unreasonable to suppose that the water percolating through the rocks possessed a high temperature, because it is not unlikely that a higher temperature than the present prevailed after the Lower Silurian strata had been deposited. With regard to the manner in which the copper may have been dissolved, and held

in solution by the water, it seems evident that it could not have existed in the water in the state of sulphate of copper, from the oxydation of impregnated copper pyrites; because such a solution on coming in contact with limestone would have formed with it sulphate of lime and carbonate of copper. Nor is it possible to ignore the physical properties of copper pyrites, and suppose it to have been, to however slight an extent, soluble in water. The only solvents known for heavy metallic sulphurets, are the alkaline sulphurets. Many heavy metallic sulphurets when fused with sulphuret of potassium or sodium, yield when treated with water, solutions containing considerable quantities of the heavy metals; and I have found that on fusing a regulus containing iron, copper, cobalt and nickel, with sulphate of soda and charcoal, and treating the result with water, a dark green solution was obtained, containing, after careful filtration, all four of these metals. This solution, on exposure to the air, gradually oxydized, became colorless, and deposited the metallic sulphurets as a black powder. I am not quite prepared to assert that the copper in the veins above referred to was deposited in this manner; but I am of opinion that if we are to adopt the theory of secretion from the side rock, this is the only explanation which is admissible. The third theory of the source of the copper is probably the correct one, and it is the one which is most in accordance with generally received opinions. Cotta, for instance, regards it as certain that mineral veins proper have been filled up by infiltration, and that the material thus deposited came from beneath.* If we however attempt to go a step beyond this general explanation, we must enquire as to the nature of the solvent, and in doing so can scarcely arrive at other results than those mentioned in connection with the second theory. We must regard the alkaline sulphurets as the most probable solvents under the circumstances; and when we reflect that the sulphurets of platinum, gold, mercury, tin, tellurium, antimony, arsenic, vanadium, molybdenum, tungsten, nickel and iron, are all soluble in alkaline sulphurets, it will appear that the latter may have played a more important part in the formation of ore veins than has been hitherto supposed. When moreover it is remembered, how numerous and diverse the double sulphur salts are, and how many of these, especially arsenic and antimonious sulphurets

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* Cotta: Erzlagerstätten, p. 127.

occur in ore veins, the importance of the agency of the alkaline sulphurets in the filling up of such can scarcely be over-rated.*

This sketch of the recent results of mining at Acton, would scarcely be complete without a description of the processes employed for concentrating the ore, and a reference to certain experiments instituted for the purpose of ascertaining the amount of copper lost in the processes of crushing and jigging.

As soon as the ore has been brought to the surface it undergoes the process of coarse spalling; that is, it is separated from the waste rock, and broken into pieces having a diameter of from four to six inches. These pieces are sorted, according to the quantity of copper they contain, into first quality ore, second quality ore, crush ore and fourths. The first three sorts then undergo the process of fine spalling. The first quality ore is broken into pieces of the size of an egg, and any poor rock which these may contain is picked out. It thus yields marketable first quality ore, containing from eighteen to twenty-four per cent. The second quality pieces, treated in the same way, yield marketable second quality ore, containing from ten to thirteen per cent. The

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Editor's note, by T. Sterry Hunt. F. R. S.

De Senarmont, in his researches on the artificial formation of the minerals of metalliferous veins by the moist way, has shown that by the aid of heated solutions of alkaline sulphurets and bicarbonates, at temperatures of 200° and 300° Centigrade, it is possible to obtain in a crystalline form many of the native metals metallic sulphurets, and sulpharseniates, besides quartz, fluor spar and sulphate of barytes. These observations, and those of Daubrée are cited by me in a paper in the *Naturalist* for December 1859, p. 500, with the remark that, in them, "we have, beyond a doubt, a key to the true theory of metalliferous veins.'' Heated alkaline solutions (sulphurets and carbonates,) which are at the same time the agents of metamorphism, dissolve from the sediments the metallic elements which these contain disseminated, and subsequently deposit them, with quartz and the various spars, in the fissures of the rock." Mr. Macfarlane's view seems to be in perfect accordance with the theory which I have advanced. The notion that the contents of the vein have been deposited from springs coming from below, is in no way inconsistent with that of their secretion from the wall-rock, inasmuch as we conceive that metalliferous and other mineral waters, in all cases, derive their soluble matters from certain permeable strata, and may afterwards either deposit these dissolved matters in the same strata, or more frequently rise to higher formations, where a lower temperature is more favorable to the precipitation of the dissolved elements.

crush ore, after having been spalled down, and separated from the waste rock, assays from three to five per cent. It is further treated by crushing and jigging. The so-called fourths consist of limestone containing copper pyrites in coarse grains, small strings and finely disseminated particles. This quality is not worked up at present. It is piled in separate heaps, in order to be treated by stamping and washing, so soon as the apparatus for that purpose is procured. Besides the coarser rock, there is produced, in the various workings, smalls, which consist of pieces of ore and rock whose diameter does not exceed three or four inches, and which are usually so coated with mud as not to be easily separable from each other. These smalls are first thrown upon a screen, the bars of which are one and a quarter inches apart; the larger pieces which remain upon it are sorted and spalled in the same way as the coarser rock; while the smaller pieces, which pass through, and assay from two to three per cent, are at once subjected to crushing and jigging.

The crush ore, and the finer part of the smalls, are reduced, by passing between cast iron rollers, to such a size as to pass through a sieve of twelve holes to a square inch. The crushed product is then brought into a jigging sieve, having sixty-four holes to a square inch. This sieve is wholly immersed in water, where it receives a succession of jerks, each of which causes it to descend, and suspends its contents in the water. These then arrange themselves according to their relative specific gravities; the richest and largest particles at the bottom of the sieve, the poorest and smallest at the top. After the sieve has received a sufficient number of jerks, it is raised out of the water, and the upper layer, or skimmings, scraped off. These contain from one and a-half to two per cent copper, and are thrown aside. That part which collects at the bottom of the sieve, and contains twelve to fourteen per cent of copper, is called ragging, and is a marketable product. There is sometimes produced an intermediate sort called seconds, occupying a position on the sieve between the skimmings and the ragging. This is laid apart, and afterwards re-jigged, the same products being produced as those above mentioned. In this process of jigging a considerable portion, the finest part of the crush work, falls through the sieve into the box below, which contains the water, and is called hutch-work. This, on being washed in a streak from the slime which it contains, assays from

eight to eleven per cent. and is then in a marketable state. The costs of these various dressing operations were as follows :—Coarse spalling costs from fifteen to twenty-five cents per cubic yard of rock, according as the same contains less or more ore ; fine spalling from fifty to eighty cents per ton of the resulting ore, according to the quality of the rock operated on. The processes of crushing and jigging cost during January, February and March, 1682, $5.60 per ton of products, and $1.15 per ton of crush ore. The total expense of coarse and fine spalling, and crushing and jigging, per ton, of all the products is at present $5.25.

The crushing and jigging processes are almost the same as those adopted in Cornwall for the dressing of crush ore, yet they are attended with the loss of much of the copper contained in the original crush ore. Having for a long time estimated the quantities, and assayed the samples of the crush ore put through the rollers; and ascertained the weight and contents of the resulting products, I have found that the loss of copper is much more than might at first sight be imagined. I subjoin a few of the results obtained: From the 17th of November to the 12th of December, 1861, there were crushed 956,760 lbs. of ore, containing 4.6 per cent, or 44,010 lbs. copper. From this there were produced 283,451 lbs. of products, averaging 10.95 per cent, and containing 31,052 lbs. copper. There were consequently lost 673,309 lbs. of skimmings and slimes of 1.92 per cent, containing 12,958 lbs. copper. Thus 29.5 per cent of the copper contained in the crush ore was lost in the skimmings and slimes. Further, during January, February and March, 1862, there were crushed 2,881,100 lbs. of ore averaging 3.4 per cent, and containing 100,303 lbs. of copper ; from which there were roduced 615,520 lbs. of products averaging 9.5 per cent, and containing 58,711 lbs. of copper. There were consequently 2,265,580 lbs. of skimmings and slimes of 1.83 per cent, containing 41,592 lbs. of copper. Thus 41.5 per cent. of the copper contained in the crush ore was lost. It is to be remarked, however, with regard to the foregoing results, that much of the copper contained in these skimmings and slimes is with proper appliances recoverable. Subsequent to the first of July, 1862, arrangements were made for dressing the ore by contract, and for working up a part of the slimes as these were being produced. Under this system the following result was obtained :—During

the months of July, August and September, 1862, there were crushed 3,348,887 lbs. of crush ore and smalls, of from 2.0 to 5.9 per cent, averaging 4.1, and containing in all 137,969 lbs. of copper. From this there were produced 1,073,644 lbs. of products of from 8.0 to 12.6 per cent., averaging 9.9 per cent, and containing 106,625 lbs. of copper. There were consequently cast aside 2,275,243 lbs. of skimmings and slimes, averaging 1.38 per cent, and containing 31,344 lbs. of copper; which is equal to 22.7 per cent of the copper contained in the original ore.

From the results here narrated, it would appear that at least one-fourth of the copper contained in the crush ore is lost in the process of dressing it. The actual value thus wasted goes far to counterbalance the saving of freight which results from concentrating the ore. It would not certainly be attended with greater advantage to send the crush ore of four or five per cent to market instead of dressing it; but it admits of plain proof, that it would be better at once to sell an ore of seven per cent, and pay freight on it to Boston or New York, rather than to submit it to further concentration by crushing and jigging, and sustain the great loss of copper which occurs in these operations. The following calculations will be found to confirm this statement:

100 tons of 7.0 per cent ore would bring in Boston $4.00 per unit; which for 6.5 per cent, (½ per cent being deducted for the difference between dry and humid assay) is equal to $26.00 per ton,..........		$2600.00
From this deduct freight, barrels, &c., at $9.00 per ton,		$900.00
There remains,..................		$1700.00
On the other hand, 100 tons of 7.0 per cent ore would yield, by crushing and jigging, about 43¾ tons of 12.0 per cent products; which would bring, say at $4.30 per unit, for 11.5 per cent, $49.50 per ton,...		$2163.43
From this deduct:		
Cost of crushing, &c., at $5.50 per ton,.....	$240.70	
Freight and barrels, at $9.00 "	393.75	634.45
There remains,..................		$1528.98

or $1.71 per ton less than when at once sent to market. It is thus evident that an advantageous concentration of a seven per cent ore by means of crushing and jigging, is not possible. The

question next arises, as to whether such an ore could not be smelted at the mines, and a large part of the cost for freight and barrels saved :—

100 tons of this ore might, by smelting, be made to yield $16\frac{2}{3}$ tons of regulus of 36.0 per cent (even supposing that one-seventh of the copper were lost in the operation). This would be worth, at \$4.50 per unit, or \$162 per ton,..............................		\$2700.00
From which deduct :		
Cost of smelting, at \$5.00 per ton,.........	\$500.00	
Barrels and freight, \$9.00 "	150.00	650.00
There remains,..................		\$2050.00
The 100 tons of 7.0 per cent ore sent to market, would have yielded, according to the previous calculation,..		1700.00
Consequent profit by smelting...............		\$350.00

or \$3.50 per ton of seven per cent ore. It would thus appear that the best mode of treating the crush ore would be to separate from it as much seven per cent ore as possible, and to treat the refuse from this, which might assay two per cent, by stamping and washing. Of this two per cent ore, the fourths (now set aside) would, on being worked up, yield a large quantity ; and although they might be unable to bear much of the mining expenses, would considerably more than pay the cost of their own concentration.

In order to ascertain the fitness of some of the products for metallurgical treatment, the following examinations were made towards the close of last year. A sample of first quality ore from No. 4 shaft gave,

Silica......................	25.12	
Carbonate of lime............	33.10	
Iron........................	5.81	
Copper.....................	24.75	
Sulphur,....................	11.22	by difference.
	100.00	

A sample of ragging gave :—

Silicious matter	16.92	
Carbonate of lime	53.07	
Carbonate of magnesia	trace	
Iron	4.06	
Copper	13.07	
Sulphur	11.62	by difference.
	100.00.	

A sample of hutch-work gave :—

Silicious matter	24.32	
Carbonate of lime	53.10	
Carbonate of magnesia	2.10	
Iron	3.36	
Copper	9.95	
Sulphur	7.17	by difference.
	100.00	

From these results, and from others previously given, it will appear that silica and lime are almost the only slag-producing materials contained in these ores. Iron is present in small quantity, but without previous calcining, which in this case is inadmissible, it would go to the formation of the regulus. The compounds of silica with lime are all but infusible; but these substances form with iron oxide, easily fusible slags, which are frequently produced in copper-smelting works. In smelting the Acton ores, therefore, a flux containing iron oxide, such as puddling slag, or roasted iron pyrites, is indispensable. The cost of these would not add very materially to the expense of smelting; but it would of course be better, if such could be had in the neighborhood, to use in place of these fluxes, poor pyritous copper ores, previously calcined.

The total product of the Acton Mine during the period to which this paper has reference, viz., from September 1st, 1861, to September 30th, 1862, was 2336 tons of 2,352 lbs.; or 2,747 tons of 2,000 lbs, the average copper contents of which amounted to 12.0 per cent. This is equal to an average monthly production of 179 tons of ore of 2,352 lbs., or 211 tons of 2,000 lbs. In reality, however, the production was much greater in the summer than the

winter months. For instance, the total produce during July, August and September last, was,—

$366\frac{1868}{2352}$	tons	first quality	ore.
$80\frac{1019}{2352}$	"	second "	"
$150\frac{922}{2352}$	"	ragging	
$312\frac{2075}{2352}$	"	hutch-work	
$84\frac{882}{2352}$	"	buddle-work	

$994\frac{2062}{2352}$ tons in all, or 331 tons monthly.

With regard to the future of the mine, I see no reason to doubt that it will be as successful as its past; provided always that a due amount of prospective work is done, and that arrangements are made for saving freight, and increasing the value of the poorer ores, by smelting the products of the mine on the spot. To this must of course be added prudent and economical management, without which even the richest mines yield little profit.

In conclusion, I have to remark, that it may seem to some, that in the foregoing, I have been unnecessarily minute. I have, however, thought myself justified in going into detail, by the altogether exceptional character of the deposit. As far as I am aware, there is no instance known of a mineral deposit bearing even a moderate resemblance, in its various relations and characters, to that of the Acton Mine; and, consequently, it is impossible to draw on any stock of experience gained elsewhere, for guidance in exploring it. That the future of the mine may be successful, and its permanency established, no fact, however seemingly trivial, observed in its earlier working ought to be regarded as unimportant. That other deposits of a similar nature may yet be discovered in the district is not impossible; and in the working of such, the experience gained at Acton may not be altogether valueless. For these reasons I have, in the foregoing paper, mentioned details and minutiæ, which few may find useful; but at the same time I trust there will be found in it matter of more general interest.

Actonvale, Canada East, 28th October, 1862.

MISCELLANEOUS.

ON THE AGE OF THE PYRAMIDS OF EGYPT.

Mahmoud Bey, astronomer to the Vice-roy of Egypt, has just published the results of his investigations of the pyramids, undertaken at the request of the Vice-roy. The measures of the great pyramid he finds to be 231 meters for the sides of the square base, and 146.5 meters for the height; so that the faces form an angle of 54° 45′ with the horizon. This agrees with the known inclinations of the six other pyramids of Memphis; which vary between 51° and 53°, and average 52° 30′. This common inclination; and the fact that the pyramids, and the other funereal monuments which surround them, are, as Mahmoud has satisfied himself, always placed exactly facing the four cardinal points, suggests that these pyramids had some relation to a celestial phenomenon, and to the divinity which presided over that in the Egyptian mythology. Now he has found that Sirius, when it passes the meridian of Gizeh, shines vertically upon the southern face of the pyramids; and in calculating the change in the position of this star for a series of centuries, shows that 3,300 years before the Christian era, the rays of this star, at its culmination, must have been directly perpendicular to the southern face of the pyramids, inclined at an angle of 52° 45′ with the northern horizon. According to the principles of astrology the influences of a star are greatest when its rays fall perpendicularly upon an object. If now we suppose that these pyramids were constructed a little more than 5,000 years ago, it would appear evident that their faces received the angle of 52 degrees, in order to be perpendicular to the rays of Sirius, the brightest star of our northern heaven; which was consecrated to the god Sothis, the celestial dog, and the judge of the dead, and was also said to be the soul of this deity.

This opinion is confirmed in an unexpected manner by the following considerations. The pyramids, being tombs or funereal monuments, would naturally be under the patronage of that divinity who presides more particularly over the dead, that is to say with Sothis, who is no other than the thrice-great Hermes, Cynocephalus, Thoth or Anubis. Now the hieroglyphic designation of Sothis is a pyramid by the side of a star and a crescent. Nothing is therefore more natural than this relation thus discovered by Mahmoud Bey between Sirius and the pyramids. The date of

3,300 B. C., thus assigned to these structures, accords with Bunsen's determination, according to which king Cheops reigned in the thirty-fourth century before our era. It also agrees with the tradition of the Arabs, according to which they were constructed three or four centuries before the deluge; which they assign to the year 3,716 before the Hegira.—(*Le Cosmos, Nov.*21*st*, 1862.)

T. .S .H.

ON THE CAUSE OF ATTRACTION.

The Rev. Father Secchi, the learned director of the Roman Astronomical Observatory, has just published an essay, in which he discusses from an advanced point of view the theory of attraction After having shown, in accordance with the views so ably expounded by Mr. Tyndal in his paper on Force, published in the *Naturalist*, (p. 241,) that all the physical forces or movements of which we are cognizant come to us from the solar centre, the learned Jesuit inquires, "But how does this movement or series of movements return to the sun? Who knows but what that part of the heat thus emanating from the sun, which is not lost by radiation into space, is converted into an impulsion of the mass of the earth towards the sun? I do not pretend to give a theory, but only to propose a conjecture, which it will be sufficient for me to show not to be absurd."

"We see that the intensity of heat, like that of gravity, diminishes inversely as the square of the distance. We know also that a prodigious quantity of molecular movements come from the sun by luminous and calorific radiation, and under the form of vibratory disturbances, remain, apparently destroyed, at the earth's surface, instead of being lost by radiation towards the planetary spaces. In fact, heat coming from sources of a very high temperature (that is to say, heat of short undulations,) when brought to a lower temperature, (or to long undulations,) can no longer traverse the terrestrial atmosphere and radiate into space. A certain quantity of motion coming from the sun must thus rest imprisoned in terrestrial bodies, by the chemical force to which it gives rise. So that in reality the *vis viva*, and the *quantity of movement* in the terrestrial globe, and its surrounding mass of ether, must increase indefinitely, if there were not some way of escape or discharge. Why may not this discharge be the incessant fall of the earth towards the sun, a fall expressed by the linear dis-

tance which the earth deviates from the tangent of its orbit; which tangent the earth would follow, in virtue of its inertia, did not some cause draw it towards the solar centre?"

Of this brilliant and novel conjecture, the learned editor of *Le Cosmos*, from whom we extract the above, remarks, that it seems to be one of those happy inspirations which belong to truth alone; and he adds, "there is great merit in having originated an idea which has never before presented itself to the human intelligence and which, in time to come, may bring forth fruitful results."—*Le Cosmos, Nov.* 21, 1862. T. S. H.

REVIEW.

DANA'S MANUAL OF GEOLOGY.*

In no part of the world has the science of geology been more successfully cultivated than in North America. But the results that have been arrived at, are scattered through a multitude of reports of the different surveys, and papers of greater or less length in the scientific journals. Up to the present time he who has endeavored to get a clear idea of the geology of the whole North American continent has found it necessary to devote more time and means to the object, than most students can well afford. In the important work, just issued by Professor Dana, this great difficulty is removed. We have now in one compact and beautifully illustrated book, not only a comprehensive and well-balanced account of the elementary principles of the science, but also the general results of what has been ascertained of the geology of this continent, down to the present moment. We have not, just now, leisure to give a full review of this excellent publication, and must therefore content ourselves with a mere glance at its contents. Prof. Dana has divided his subject into four parts, as follows.—

1. Physiographic Geology.—In this part of the work, are described the forms of the earth's surface, as exhibited in the

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* Manual of Geology: treating of the principles of the science with special reference to American Geological History, for the use of Colleges, Academies, and Schools of Science. By James D. Dana, M. A., LL. D., Silliman Professor of Geology and Natural History in Yale College, &c., &c. Illustrated by a chart of the world, and over one thousand figures, mostly from American sources. Philadelphia: published by Theodore Bliss & Co. London: Trübner & Co. 1863. Small 8vo, pp. 812.

distribution of the land and water; the directions of certain physiographic lines, in conformity with which the boundaries of the continents, the ranges of islands and chains of mountains are arranged; the system in the reliefs or surface-forms of the continental lands; the system of oceanic and atmospheric currents, and the general laws of the distribution of forests, prairies and deserts. All these phenomena are within the domain of physical geography, but they can never be well understood unless investigated through geology, as their origin dates far back in time.

2. Lithological Geology.—Relating to the composition and different kinds of rocks.

3. Historical Geology.—Under this title is discussed the main portion of the subject; the description in their order, of all the formations from the most ancient up to the most recent. Here we have, for the first time, the science of geology elucidated by special reference to the series of American rocks; thus removing the great difficulty we have pointed out in the first lines of this notice. Full details of all the deposits, their lithological composition, their characteristic organic remains and geographical distribution are given. There appear to be about 700 figures of fossils, nearly all of which were drawn on wood by Mr. F. B. Meek, an accomplished artist, and one of the best palæontologists of the continent. Most of the species figured are American, and several of them are from the Decades of the Canadian Survey, representing peculiar forms only possessed by the Provincial Collection of Canada. It is not uncommon to find works on general geology illustrated by figures, which, for all natural-history purposes, are perfectly worthless. This must happen when neither the artist nor the author is a naturalist. In the book before us, the illustrations are first-class, for the reason that all the parties engaged in their production, perfectly understood how to prepare them.

4. Dynamical Geology.—This division treats of the causes of events in the earth's geological progress. "These events include the formation of all rocks, stratified and unstratified, with whatever they contain, from the earliest Azoic to the modern beds of gravel, sand, clays, and lavas; the oscillations of the earth's crust; the increase of dry land, elevation of mountains, and elimination of the surface features of the globe; the changes of climate; the changes of life."

The work concludes with an appendix and a copious index.

Geology is a science of such vast extent, and so largely com-

posed of all others, that few men possess the almost universal knowledge required to produce a good manual of its elementary principles. The author of this work being a profound geologist mineralogist, zoologist, and physicist, is one of the best qualified for the task. His book is a great one, and its publication will mark the commencement of a new era in the progress of the science. In conclusion we would strongly recommend it to the Canadian student. With the General Report on the Geology of Canada, soon to be published by Sir W. E. Logan, the Decades of the Survey, and Dana's Manual, he can enter the field unimpeded by the crowd of difficulties to which observers in this province, have heretofore found themselves opposed at the very outset.

E. B.

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